



Faculty of

**Engineering**

## RESEARCH PROJECTS

### **A State Space Approach to Recurrent Neural Network**

- ✉ CHAN Lai Wan • KING Kuo Chin Irwin
- ☐ 1 September 1997
- ❖ Research Grants Council

In this project, the researchers will investigate the use of State-Space approach to the training of the recurrent neural networks. They will adopt the Recursive Least Square Method or the Kalman filter to train the recurrent networks. Previous results indicate that the training algorithm based upon the extended Kalman filter for feedforward network requires significantly fewer iterations than the gradient descent algorithms. They will apply the Extended Kalman filter method to the training of recurrent networks and will do comparative studies on the Kalman filter based algorithm to the gradient based algorithm in recurrent networks.

In many problems, it is not uncommon to have some observations missing in the input series or arriving at an irregular time interval. This poses a major difficulty to some approaches such as ARIMA model. The Kalman based method is an on-line approach and it does not require the assumption of data being equal-time interval. Thus, they will extend their learning method to handle the missing data. Financial data, such as the foreign exchange rates, are non-stationary and have many missing data and therefore, they will apply their recurrent network model to the forecasting of these financial time series.

(CU97560)

### **An Intelligent Virtual Environment for Bronchoscopy Simulation**

- ✉ HENG Pheng Ann • LEUNG Kwong Sak • TSUI Hung Tat (Electronic Engineering) • YIM Ping Chuen Anthony (Surgery) • ABDULLAH Victor (Surgery)
- ☐ 1 September 1997
- ❖ Research Grants Council

In this project, the researchers propose to develop an intelligent virtual environment for computer simulation of bronchoscopy, a medical procedure used to diagnose and treat lung diseases. The environment consists of capabilities for 3D reconstruction of lung and tracheobronchial tree from patient's spiral CT data, interactive navigation within the lung from the viewpoint of the pulmonary bronchoscopist, and enhancement of visibility of the lung structures that normally not seen by the bronchoscopist. Such an environment will be useful for surgical planning since it will provide a pre-

operative 3D map of the patient's airway, and any critical airway stenosis would be discovered and an optimal surgical path could be planned before hand. In addition, such a system could be useful to train medical students or physicians in performing bronchoscopy so that they can reach a high level of skill before working on living patients.  
(CU97555)

### **Image Based Rendering with Controllable Illumination**

- ✉ HENG Pheng Ann • WU En Hua\*
- ☐ 1 November 1997
- ❖ CUHK Research Committee Funding

One current trend in rendering is image-based rendering. Image-based rendering systems generate different views of an environment from a set of pre-acquired imagery, and allow interactive navigation of image-based virtual environments on a low cost computer system. One representative system is the Quick Time VR developed by the Apple Computer, Inc. The main applications of such a system include web-based virtual environment exploration, virtual shopping, real estate property inspection, architecture visualizations, and virtual reality games.

However, previous image-based rendering research is only for non-illuminatable image-based object. That is, once the image is recorded, there is no way to change the illumination of the captured scene. Hence, all the lighting setup of the scenes have to be carefully designed. More seriously, the captured image-based objects will be unrealistic when it moves or rotates in the virtual environment. Strictly speaking, previous works are only partial solutions to the rendering problem of the image-based objects. In this project, the researchers will develop a comprehensive and practical image-based rendering system for image-based objects with controllable illumination. Once it is done, real world objects can be captured using hand-held cam-corders. It allows interactive change of view points as well as change of illumination to achieve more realistic image-based rendering.

(CS97005)

### **Working Model for Intranet Commerce in Fabric Sourcing and Trading**

- ✉ KING Kuo Chin Irwin • XU Lei • FU Wai Chee, Ada • CHAN Lai Wan
- ☐ 1 September 1997
- ❖ Industrial Support Fund, Industry & Technology Development Council

The target users of the project will be fabric suppliers and garment manufacturers. To the textiles and apparel industry as a whole, the project will catalyse

the industry in the application of electronic commerce which will shorten order lead time and reduce order handling cost. Consequently this will strengthen the industry as the global sourcing centre. Specifically, to fabric suppliers, the project will enable them to penetrate into a wider international market with an affordable cost. On the other hand, to garment manufacturers, the project will enable them to source with much wider choice, therefore demand from their customers can be satisfied with more ease. (CS97003)

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### Content-Based Image Retrieval of Classical Chinese Paintings and Calligraphy

✉ KING Kuo Chin Irwin • FU Wai Chee, Ada • CHAN Lai Wan

□ 1 December 1997

❖ Research Grants Council

The researchers propose to develop a content-based image retrieval system for efficient accessing of classical Chinese paintings and calligraphy. The system uses image features such as color, shape, texture, and sketch to access digitized Chinese paintings and calligraphy from various artists in different dynasties and regions in the Chinese art archive.

This system contains theoretical importance as well as practical significance. The system is useful for the theoretical study of combining advanced imaging technology with database indexing methods for efficient retrieval in multimedia databases. Moreover, the system with its ease-of-use interface is a practical academic research tool as well as a teaching aid of classical Chinese art in universities and museums. It can be used for archival, data navigation, and data exploration of classical Chinese fine arts. (CU97569)

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### CUVIR: Comprehensive and Uniform Access to Visual Information Repositories

✉ LEE Moon Chuen

□ 15 October 1997

❖ Research Grants Council

The project aims at providing new and effective mechanisms for comprehensive and transparent access to visual information repositories, providing the needed coherence and uniformity in navigation and access. To this end, the researcher plans to develop a uniform content-based indexing and retrieval framework for visual information repositories, supporting multi-level, multi-index features, and incorporating both descriptive metadata and computed feature indices. The inherent relationship within the different visual information types and the similarity in their contents are exposed

at the various levels of the index hierarchy, while the multiple index approach provides access via various natural cues with which users may view the visual information contents. The core research issues include the development of such a uniform framework, derivation of some new and effective index features, and development of efficient algorithms for feature extraction. Also, he plans to address the new research problems introduced by the new approach adopted - namely multi-paradigm similarity matching, similarity ranking and relevance clustering, and unification of indices. In addition, new methods for visual query specification, query re-formulation and query transformation in a hierarchical, multiple-index retrieval environment will be developed. (CU97557)

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### Co-operative Constraint Satisfaction Among Intelligent Agents

✉ LEUNG Ho Fung • LEE Ho Man Jimmy • CLARK K. L.\*

□ 1 August 1997

❖ UK/Hong Kong Joint Research Scheme, the British Council

This project aims at investigating the problem of co-operative constraint satisfaction problem in intelligent multi-agent systems. A co-operative constraint satisfaction problem can be intuitively understood as follows. Consider a system in which there are a finite number of autonomous intelligent agents. Concerning the assignment of values to the same set of variables, each of these agents has its own set of constraints to be satisfied. The constraints of different agents may share common variables. Each variable, whether it is shared by more than one agent or not, can take value only from its associated domain (which a finite set of discrete constants). The goal is to devise a protocol for these agents to communicate, negotiate and (possibly) compromise so that either

(1) a global solution that all agents accept is found or

(2) it is confirmed that no such solution exists.

Topics of investigation include agent theory, architecture and communication language. (CS96003)

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### An Automatic Learning System Based on a Novel Generic Evolutionary Programming Framework

✉ LEUNG Kwong Sak • WONG Man Leung\*

□ 1 September 1997

❖ Research Grants Council

Software development is time consuming, costly, and error prone. Automatic programming and knowledge

discovery such as data mining are popular current research topics. Program induction can handle both of these two problems and hence is becoming a very important research area. However, existing program induction systems are limited in the techniques and the programming languages used for the induced programs. Based on the researchers' experience on evolutionary algorithms and inductive logic programming, they are proposing to formulate a framework, called generic evolutionary programming (GEP), integrating different kinds of evolutionary algorithms and inductive logic programming techniques. The framework can facilitate the exchange and reinforcement of information, techniques and theories amongst these fields. A new theory for evolutionary program induction will be formalized and a powerful learning system based on the theory and the framework will be developed. The system with many integrated and improved evolutionary operators and functions can learn programs in various programming languages and represent context-sensitive information and domain-dependent knowledge which can be used to accelerate the learning speed and/or improve the quality of the programs induced. (CU97554)

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**Providing Multi-Resolutions, VCR Functionalities, Load Balancing and Fault-Tolerance Features in a Video-On-Demand Storage Server via Subband Coding Techniques**

- ✉ LUI Chi Shing John
- ☐ 1 October 1997
- ❖ Research Grants Council

Supporting VCR functionalities is an important requirement for the design of a Video-On-Demand (VOD) system. Most often, techniques proposed in providing VCR functions may require additional system resources. In this research, the researcher proposes to use subband coding techniques to provide various VCR functions. Beside proposing an efficient method of providing the essential VCR functionalities, the VOD system can also provide multiple resolutions to viewers based on their quality of service (QoS) requirement. In this research, he will study various data placement algorithms that can provide the following important features:

- (1) easily support VCR functionalities such as fast forward with viewing, fast rewind with viewing, pause and resume operations,
- (2) during the periods in which VCR functions are employed, no additional system resources (e. g., I/O bandwidth, buffer and network bandwidth) are required,
- (3) load balancing feature is maintained throughout the period of normal and VCR display,

In this research project, he plans to formulate the theory and the design work for such kind of high performance VOD system. (CU97564)

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**Physics-based Picking Functions of Virtual Hand Models**

- ✉ SUN Hanqiu
- ☐ 1 January 1998
- ❖ CUHK Research Committee Funding

Virtual Reality (VR) introduces the potential, immersive 3D user interactions in computer synthesized worlds. Data glove devices, as one of the three dimensional devices in VR, sense both static hand shapes and dynamic hand movements. The use of data glove devices in hand-oriented tasks, such as robot hand/arm simulation, is currently limited to simple button-press and command-trigger type of interaction. The full control flexibility of the whole hand input in handling the objects has not been systematically studied and modelled, which lags the use of intuitive, dexterous hand input in the virtual mechanical tasks.

This research investigates the picking functions of a virtual hand controlled by the physical laws that count the gravity, surface resistance, contact points, and finger acting forces on the object. The goal is to develop physically-realistic picking behavior of virtual hand models and real-time optimal controllers of the tree-like structure for various picking tasks in off-line robot assembly programming. The output of the research introduces better human-computer interaction by providing physics-based realism in virtual hand functions, which makes the switching between real and virtual operation modes transparent to the user. The intuitive, dextrous hand functions to be developed will benefit the VR user community of Hong Kong for the easy construction of higher-level 3D user interfaces and VR applications. (CS97004)

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**Recovery for Transaction Failures in Object-Based Databases**

- ✉ WONG Man Hon • FU Wai Chee, Ada
- ☐ 1 September 1997
- ❖ Research Grants Council

Most of the existing commercial database systems are based on the read/write model. However, concurrency provided by these systems is not high enough to meet the need of high performance on-line transaction processing. A number of researchers have proposed to model a database by a collection of semantically rich data objects and show that this model can permit more concurrency. However, the technique for handling the recovery issues in the

semantically rich data objects is not fully developed. Recently, the researchers have derived a new recovery model for the object-based databases. In this project, they propose to develop a set of recovery theory and to build a prototype to evaluate the performance and study the implementation issues of the semantics-based recovery system.  
(CU97559)

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**A New FPGA Architecture and Design Automation Methodology for High Chip Performance and Fast Circuit Mapping**

✉ WU Yu Liang • WONG Chak Kuen • MAREK-SADOWSKA Malgorzata\*

□ 1 December 1997

❖ Research Grants Council

The circuits built by current FPGA architectures have been shown to be unsatisfactory in circuit delay (performance), and the process of mapping electronic circuits onto FPGA chips is also too slow for large implementations. The objective of this research is to develop a new FPGA framework which incorporates a new architecture (Coupling-FPGA) together with a novel design automation approach (Greedy Synthesis) to achieve the challenging goals of high circuit performance and rapid circuit mapping at the same time. In the new design method, the traditionally separated placement and routing steps can be bound into one, and the dynamic placement and routability information can be linked with a powerful circuit transformation method so as to make appropriate area-speed trade-off decisions at a higher circuit mapping stage. The researchers will perform analytic and empirical studies using real-world circuit examples and compare results with current known industrial and academic models to demonstrate the effectiveness of the techniques proposed in this project.  
(CU97556)

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**Theoretical Studies and New Algorithms for Information Theoretic Blind Source Separation**

✉ XU Lei

□ 1 November 1997

❖ CUHK Research Committee Funding

Blind source separation ability is a fundamental property of an intelligent sensor and perception system, e.g., the human hearing system is able to separate the sounds from different speakers in a {em cocktail-party}. This ability is very important to many engineering systems where the signals received by its sensors are not simply the expected source signals, but usually a type of their mixture. One example is that a communication device used in a very noisy or strong interfering environments, such as

car-phones, cellular phones in crowded areas, phones in aircraft pilot room, as well as hand-free telephones. Similar examples can also be found in intelligent electronic medical instruments (e.g., electromyograms, electrocardiograms, X-rays, as well as many others), in radar or water sonar systems, high performance stereo recording systems, voice controlled machines, robotics, semiconductor manufacturing systems, as well as voiced based inspection systems for security or military use. A good ability of separating each source signal will significantly improve the quality of these systems. However, by its nature, blind source separation is a very challenging difficult problem, because the researchers want to recover the unknown mixing system and input source signal from only the mixed observations. To tackle this problem, each source signal is assumed to be independent from each other, and thus the problem is also called Independent Component Analysis (ICA). Currently, the achievements obtained are really limited in the literature. This project targets to (1) developing a promising but yet not well-developed information theoretic ICA approach by using a new theoretical analysis tool to obtain several important theoretical results on the sufficient and necessary conditions as a systematic theoretical solution for the ICA problem; (2) developing a general ICA algorithm that can automatically adapt to match some statistical properties of the source signals, which, as they expected, will claim a general applicable practical solution for the ICA problem; (3) developing a new formulation with new implementation algorithm for the ICA problem by removing the unreasonable implicit assumption of i.i.d. samples in its current formulation so that the serial correlation within each signal can be preserved and thus it is more practical to the real time blind source separation.  
(CS97006)

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**Please refer to previous issues of this publication for more details of the following ongoing research at the department:**

<u>Edition</u>	<u>Title/Investigators</u>
1995-96	Uniformly Polynomial-time Algorithms for Parameterized Families of Graphs (CU95510) ✉ CAI Leizhen
1996-97	A Theoretical Study on Two New Types of Reliable Networks (CU96537) ✉ CAI Leizhen
1995-96	Sequential Signal Processing Using Mixture Recurrent Networks (CS95018) ✉ CHAN Lai Wan

- 1996-97 Improving Generalization of Recurrent Networks in Time Series Prediction (CU96529)  
✍ CHAN Lai Wan • MOODY John\*
- 1995-96 Performance Analysis and Theoretical Studies for Replicated Databases (CU95531)  
✍ FU Wai Chee, Ada • WONG Man Hon • CHEUNG David W. L.\*
- 1996-97 Abstraction, Association and Clustering in Data Mining (CS96004)  
✍ FU Wai Chee, Ada • WONG Man Hon
- 1995-96 Interactive Volume Visualization in a Virtual Environment (CS95024)  
✍ HENG Pheng Ann
- 1996-97 A Virtual Environment for Real-time Exploratory Scientific Visualization (CS96005)  
✍ HENG Pheng Ann
- 1995-96 FACE: A Face Analysis and Computing Environment (CU95513)  
✍ KING Kuo Chin Irwin • XU Lei • CHAN Lai Wan
- 1996-97 Min/Max Entropy Principles for Unsupervised Visual Processing via Constrained Sigmoidal Neural Networks (CS96007)  
✍ KING Kuo Chin Irwin
- 1995-96 Towards an AI Architecture for Very Large-Scale Constraint Satisfaction (CS95019)  
✍ LEE Ho Man Jimmy • LEUNG Ho Fung • CHAN Lai Wan
- 1996-97 Multiparadigm Programming Language Implementation and Applications (CS96008)  
✍ LEE Ho Man Jimmy • LEUNG Ho Fung
- 1994-95 A Chinese Multimedia Presentation Authoring System (CS94012)  
✍ LEE Moon Chuen
- 1996-97 Real-time Separation of Multineuron Recordings (EE96014)  
✍ LEONG Heng Wai
- 1995-96 Real-time Logic Programming for Intelligent Control (CS95020)  
✍ LEUNG Ho Fung • LEE Ho Man Jimmy
- 1995-96 Binary Fuzzy Constraint Satisfaction Problems: Properties and Solutions (CS95025)  
✍ LEUNG Ho Fung • LEE Ho Man Jimmy
- 1996-97 Object-oriented Real-time Rule-based Programming for Intelligent Control (CS96006)  
✍ LEUNG Ho Fung • LEE Ho Man Jimmy
- 1995-96 Automatic Knowledge Acquisition in an Inexact Environment Based on Genetic Techniques (CU95514)  
✍ LEUNG Kwong Sak • WONG Man Leung<sup>#</sup>
- 1995-96 An Intelligent Database for Standard Chinese Computer Terminology (CS95026)  
✍ LEUNG Kwong Sak • YUNG K. T.\*
- 1996-97 Optimal Mappings Between Problem Models and Parallel Genetic Algorithms (CU96535)  
✍ LEUNG Kwong Sak • WONG Chak Kuen • LEUNG Yee (Geography)
- 1994-95 Methodologies in Minimizing I/O Bandwidth Demands of Multimedia Servers (CS94010)  
✍ LUI Chi Shing John
- 1995-96 Resource Management and Performance Analysis for Cost-effective Multi-media Storage Server (CU95509)  
✍ LUI Chi Shing John
- 1996-97 Parallel Numerical Solution Methods and Bounding Techniques in Solving Large Markovian Models: Applications to Computer & Communications (CS96018)  
✍ LUI Chi Shing John
- 1996-97 Operating System and Network Support for Distributed Multimedia Services (CS96016)  
✍ LUI Chi Shing John
- 1996-97 3D Motion Specification in the Virtual Space (CS96021)  
✍ SUN Hanqiu
- 1994-95 Research on a New Class of Optimization Problems Related to the Handling of Elastic 3-D Objects by Robots and Its Application in Industry (CS95008)

- ✎ WONG Chak Kuen • LEUNG Kwong Sak • HUI Kin Chuen (Mechanical & Automation Engineering) • LEUNG Yee (Geography) • ALBRECHT Andreas\*
 Squares Learning Aided by Iterative Relabelling: Theories, Algorithms, and Engineering Applications (CU94503)  
✎ XU Lei
- 1996-97 Optimal Arrangements of Flexible Objects (CU96502)  
 ✎ WONG Chak Kuen
 1995-96 Distributed and Hierarchically Structured Nonlinear Hebbian Learnings and Their Applications to Image Compression, Pattern Discrimination, Signal Blind Separation and Visual Processing (CU95512)  
✎ XU Lei
- 1995-96 Performance Analysis of Semantics Based Concurrency Control Protocols for Databases (CU94525)  
 ✎ WONG Man Hon
 1996-97 From Mixture Model to Ying-Yang Machine: New Methods for Nonlinear Time Series Modeling and Its Application to Financial and Trading Data Analyses (CU96515)  
✎ XU Lei
- 1996-97 Time-multiplexing FPGA Routing for Efficient Logic Block Sharing (EE96003)  
 ✎ WU Yu Liang
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- 1995-96 An Unsupervised Pattern Recognition Approach Based on Multi-Models Least

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**see also** <P972115>, <P973072>, <P973073>, <P973074>, <P973075>, <P974867>, <P980771>, <P980772>, <P980773>, <P980880>



## RESEARCH PROJECTS

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### Injection Locked Digital Controlled Oscillator

- ✍ CHAN Cheong Fat • CHOY Chiu Sing Oliver  
□ 1 January 1998  
❖ CUHK Research Committee Funding

In modern digital communication circuits, a conventional analog voltage-controlled oscillator (VCO) is replaced by a digital-controlled oscillator (DCO). A DCO changes its output frequency according to the binary weight of a digital control signal. A typical control signal is around 4 to 8 bits, with a resolution between 16 to 64. A DCO with resolution better than 64 requires a large number of transistors, which is not practical for most applications. The major drawbacks of DCO are limited resolution and bandwidth. In addition, a DCO is more complex than a VCO; a typical DCO requires one-to-two hundred more transistors than a VCO.

The researchers propose a new type of digital-controlled oscillator based on an Injection Oscillator technique. This new oscillator circuit preserves all the advantages of a conventional VCO, such as simple design for example, less than 30 transistors for most applications, and higher resolution and bandwidth. In addition, the new circuit also has the added advantage that the output signal can be phase locked to a control signal. This new capability simplifies the design of digital communication circuits.  
(EE97002)

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### Selective Multi-wavelength Fiber Ring Lasers for Wavelength Division Multiplexed and Photoic Switching Applications

- ✍ CHAN Kam Tai • LI Shenping  
□ 1 October 1997  
❖ Research Grants Council

The technique of fabricating fiber Bragg gratings (FBG) will be studied in detail by exposing ordinary Ge-doped optical fibers to UV illumination provided by excimer lasers through phase masks purchased from foreign vendors. Then quartz sampling masks will be designed which are intended to be used in conjunction with the phase mask for the production of sampled gratings in the optical fiber. These sampled FBGs should exhibit multiple reflection peaks so that when they are inserted into fiber ring lasers pumped by 980nm semiconductor lasers, oscillations at a multitude of wavelengths around 1550nm can be achieved. Next, various fiber laser mode-locking techniques will be studied to generate optical pulses emitting in those wavelengths simultaneously and at the common repetition rates, such as 2.488 Gbit/s, employed in optical communication. The characteristics of those light

pulses will be analyzed in detail both in the time domain and frequency domain.  
(CU97566)

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### Characterization and Modeling of CPW Discontinuities in Monolithic Microwave Integrated Circuits

- ✍ CHENG Kwok Keung  
□ 1 December 1997  
❖ CUHK Research Committee Funding

A monolithic microwave integrated circuit (MMIC) is a microwave circuit in which both active and passive components are fabricated on the same semiconductor substrate. Recently, the widespread use of Coplanar Waveguide (CPW) underline a continuous need for accurate prediction of the high frequency behavior of discontinuities such as steps, bends, air-bridges, etc. Commercial CAD tools available are mainly for the design of microstrip circuits where a moderate precision can be accepted. Models of CPW structures generally included in these softwares are based on approximations that limit their validity to quite low frequencies. A theoretical characterization based on the electromagnetic behavior of the structures seems to be the most accurate approach, unfortunately, those numerical methods are often found to be quite complicated to use and implement. On the contrary, the development of equivalent circuit models represent a proper merging of the required accuracy with the availability of friendly tools, effectively usable in practical circuit design and optimization. The objective of this project is to develop accurate equivalent circuit models of CPW structures based upon experimental characterization.  
(EE97003)

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### Transition Metal Silicides Synthesis and Devices Application by High Beam Current Ion Implantation

- ✍ CHEUNG Wing Yiu • WONG Sai Peng Joseph  
□ 1 January 1998  
❖ CUHK Research Committee Funding

This project aims to form transition metal silicides by high dose implantation with a Metal Vapor Vacuum Arc (MEVVA) source. In particular, the formation and properties of cobalt and nickel silicide by this method will be studied in details. The electrical properties will be studied by temperature variable resistivity measurements and Hall effect measurements. The microstructures will be studied by X-ray diffraction methods, cross-sectional transmission electron microscopy and scanning probe microscopy.  
(EE97004)

**Development of a Large Vocabulary Speech Database for Cantonese**

- ✍ CHING Pak Chung
- 1 August 1997
- ❖ Industrial Support Fund, Industry & Technology Development Council

Recently, man-machine communication using natural speech has received world-wide attention from both academic and industrial communities. This project is intended to facilitate the research and development in this fast growing area in Hong Kong. A large scale database of digitized speech will be designed and constructed for Cantonese, which is the most commonly used dialect in Hong Kong. The database, fully analyzed, segmented, labeled, classified and indexed, will facilitate the design, implementation and performance evaluation of voice products and services, such as answering machine, on-line enquiry services, voice-controlled devices, etc. It will be the first known speech resource of the similar kind. The target users of this database include manufacturers of Cantonese voice products in local electronic industry, telephone companies and providers of multi-lingual voice services.  
(EE97001)

**Advanced Signal Processing Techniques for Communications**

- ✍ CHING Pak Chung • WONG Kon
- 1 September 1997
- ❖ Research Grants Council

Cyclostationarity is a property whereby a signal can be characterized by a cycle frequency. The exploration of the cyclostationarity of man-made signals reveals that signals having overlapping spectra can be separated spatially by beamforming and spectrally by filtering. The capability of separating spectrally overlapped signals implies that the capacity of the communication channel can be increased by having more such signals simultaneously transmitted. Furthermore, the use of such techniques disposes of the necessity of training signals which occupy extra frequency bands or time slots. Based on the cyclostationarity of communication signals, the researchers will develop a blind adaptive filtering technique called Adaptive Frequency Shift (A-FRESH) filter which can separate and recover signals having different cycle frequencies yet having overlapping spectra. In addition, they will also design adaptive beamforming technique so that signals of different cycle frequencies arriving at the receiver from different directions can be separated and recovered achieving the effect of space division multiplexing. Not only will the proposed method

increase the transmission capacity of the channel, but also it will lead to greater enhancement of performance of the communication system.  
(CU97502)

**Automatic Synthesis of Fault-Tolerant Asynchronous Circuits**

- ✍ CHOY Chiu Sing Oliver • CHAN Cheong Fat
- 1 January 1998
- ❖ Research Grants Council

Compared with its synchronous counterpart, an asynchronous circuit has at least the following primary advantages: high speed operation, design flexibility, and low power consumption. These advantages have made asynchronous circuits more attractive in both academia and industry recently. It is important for asynchronous circuits to be able to tolerate persistent and transient faults. However, fault-tolerance in asynchronous circuits is very difficult and has received little attention. This project focuses on developing a methodology and implementing an automatic synthesis system for fault-tolerant asynchronous circuits from their behavior specification, as well as demonstrating the design methodology in a case study taken from the state-of-the-art applications. In particular, the project includes the following aspects:

- (1) A methodology and software for automatic synthesis of fault-tolerant asynchronous circuits. The main strategy of achieving fault-tolerance is to use a concurrent error detection and correction checker which is constructed from the high-level specification of the asynchronous circuits.
- (2) Effectiveness study of error coverage through analysis and simulation.
- (3) Reliability and performance evaluation of the resultant fault-tolerant asynchronous circuits.
- (4) Demonstration of the applicability and practicability of the design methodology by an extensive case study taken from the state-of-the-art applications - asynchronous image signal processing circuits.

(CU97565)

**Microcode Automation Targeted at Asynchronous DSP Processors Design**

- ✍ CHOY Chiu Sing Oliver • CHAN Cheong Fat
- 1 January 1998
- ❖ CUHK Departmental Funding

Design automation is becoming more necessary when the asynchronous systems are gaining more and more acceptance as the size and complexity of digital circuit increases. In this project, high-level synthesis software tools are developed, which can automatically map a DSP computation algorithm

behavioral description to the hardware realization in micropipeline asynchronous architecture based on the kernel units—multiple small microcode processors (SMPs). The tools are being under the development on the Sun/Altra 1/Unix platform.

The kernel of this automation method is how to automatically get the microcode, which is the central control part of the DSP algorithm hardware realization based on SMPs. So, the scheduling and the allocation, which are borrowed from synchronous high-level synthesis concepts, will be considered based on algorithms such as: A\_ASAP, A\_ALAP, A\_HU, A\_Left\_Listing, A\_Right\_Listing and A\_Force\_Directed. Before the automation, the DSP algorithm representation rules should be created based on a certain data representation rules and the Data Flow (DFG), in which no control steps exist. Meanwhile, the operation constraints rules should be created also and the hardware library resources, which contain the information of SMPs, may be supported. After the scheduling and the allocation, an order of hardware invoked operation and a data sequence can be defined, and the SMP resources can be assigned in an asynchronous timing model. In turn, a microcode sequence is generated as a result. (EE97019)

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#### **A Wideband Antenna for Ubiquitous Communication**

- ✍ LAI Kin Yue Albert • CHENG Kwok Keung
- ☐ 1 November 1997
- ❖ Research Grants Council

The past two years have seen furious development in ubiquitous wireless telecommunication throughout the world. Governments in Europe and America have freed up huge chunks of frequency spectrum and allocated or auctioned them off to service providers in different towns, cities, regions, and states providing services such as mobile phone, global satellite phone, wireless local loop, wireless multipoint distribution system, wireless metropolitan area network, wireless trunk, etc. The massive amount of data carried, including video, data and fax in addition to voice, created an ever increasing demand for wideband communication hardware.

Moreover, as the coverage of these wireless networks gradually extend to rural areas, where a wired network is too expensive for many countries, the market potential of wireless communication hardware sky-rocketed. This is now just becoming evident in rural China, for example. These rural wireless networks are expected to grow in bandwidth requirement just like their urban counterparts. To satisfy current and future requirements, research laboratories throughout the world are working hard to develop wideband hardware components for such wireless communication systems. One of the key component, a wideband antenna front-end, is the

objective of this project. This project will develop a wideband antenna with extremely wide frequency bandwidth to accommodate a large number of video, data and voice channels, highly controllable radiation pattern ranging from  $10^\circ$  to  $120^\circ$  beamwidths, high gain and high sensitivity, small size and low cost. This project will capitalize on the most recent development in numerical technologies and take advantage of rapidly increasing computation power yet decreasing memory cost of newer generation computers to analyze the antenna. Two novel features will be introduced which will be verified using another new technology: Rapid Prototyping System. If successful, this product will herald in an age where wireless communication will have reasonably comparable bandwidth to wired transmission, yet at a fraction of the cost.

(CU97506)

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#### **Speaker-Independent Speech Recognition of Chinese over the Telephone**

- ✍ LEUNG Hong Chung
- ☐ 1 September 1997
- ❖ Research Grants Council

The objective of this project is to develop a technology infrastructure for automatic speech recognition of Chinese over the telephone. There are several phases:

- (1) Establishing a research infrastructure for speech recognition over the telephone. Equipment will be set up and interfaced with the public telephone network. An automatic procedure will be developed to prepare for direct recording into a computer over the telephone network.
- (2) A large amount of Cantonese speech data will be collected over the telephone from many speakers. The database will have to be designed, speakers will have to be recruited, and the speech data will have to be labeled.
- (3) Word spotting capability will be developed to capture keywords spoken over the telephone network. Duration and acoustic modeling will be adopted.
- (4) The system will be evaluated, along with a demonstration.

(CU97561)

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#### **Spectral Dynamics in Gain-Switched Distributed-Feedback Laser Diode under the Influence of Weak External Feedback**

- ✍ SHU Ching Tat C. • TSANG Hon Ki
- ☐ 1 January 1998
- ❖ Research Grants Council

The distributed feedback (DFB) laser diode serves as a convenient and compact single-mode source of high

spectral quality. It is commonly used in optical transmitters for data and tele-communications. Unfortunately, the spectral characteristics of a DFB laser diode are often degraded under high-bit-rate modulation. The gain-switched optical pulses suffer from both an increase in frequency chirp and a reduction in the side-mode-suppression-ratio. Thus, the system performance will be adversely affected by group velocity dispersion in fibers and the accumulation of mode partition noise. A simple way to solve the problem is to construct an external cavity and feed back a small portion of the output into the laser. As the photon density at different wavelengths is modified, the carrier dynamics and the spectral content of the output will be affected. A chirp reduction and an enhancement in the side-mode-suppression-ratio of the optical pulses are expected. In this proposal, the researchers plan to investigate the dynamics of spectral modification through time-resolved measurements on the output characteristics of the pulses. The experimental data will be compared with their theoretical predictions obtained from the rate equations.  
(CU97517)

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**New Methods for Characterizing and Generating Ultrashort Optical Pulses**

- ✉ TSANG Hon Ki • SHU Ching Tat C.
- ☐ 1 October 1997
- ❖ Research Grants Council

The project will investigate novel methods for the generation and full characterization (measurement of both the amplitude and phase profiles) of ultrashort optical pulses. Methods for pulse generation include the compression of femtosecond optical pulses generated from mode-locked erbium doped fiber lasers and Ti:sapphire lasers. Ultrashort pulse characterization work will include investigating the use of the Laplacian pulse width definition and frequency resolved optical gating. Other work on pulse characterization to be carried out include improving the time resolution of the integrated waveguide two-photon-absorption autocorrelation-detectors.  
(CU97515)

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**Inferring 3D Shape Using Physics Based Techniques**

- ✉ TSUI Hung Tat
- ☐ 1 October 1997
- ❖ Research Grants Council

Inferring the shape of 3D objects has been a major problem in computer vision for over 20 years. In this project, the researcher performs shape recovery of 3D objects using the approach of physics based

techniques. Unlike the most of the physics based techniques in the past, he intends to apply his proposed methods outside a controlled laboratory and without using an ideal point light source. Recently, he has developed a number of methods for shape from shading (SFS) using multiple extended light sources, SFS for non-Lambertian surfaces, shape from color images, and shape from specular reflection. On this foundation, he plans to further develop these methods to suit practical environments. Shape from specular reflection and SFS under known practical environments will be two topics of his study. The results of this research will provide some good vision algorithms for building the robot vision systems for industrial and service robots: the robots to serve the patients and the handicapped. Service robots with physics based vision system may be working at the local homes and hospitals in the near future.  
(CU97509)

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**Scanning Probe Microscopy of the Impact of Energetic Beams on the Surface of Electronic Materials**

- ✉ WILSON Ian Howard
- ☐ 1 January 1998
- ❖ CUHK Research Committee Funding

Energetic ions are used in many of the processes used to fabricate semiconductor devices, the prime examples being ion implantation, reactive ion etching and plasma processing. In the proposed work scanning probe microscopy (SPM) will be used to investigate, at the atomic level, the interactions of ion, electron and laser beams with the surfaces of electronic materials. Low doses (typically  $10^{11}$  to  $10^{13}$  projectiles  $\text{cm}^{-2}$ ) will be used in order to prevent overlap of individual collision events so that the details of single particle events can be resolved. The subject has received the attention of several groups since the original discovery by scanning tunneling microscopy (STM) of craters formed by single ion impacts on silicon by the principal investigator but there is, as yet, little understanding of the mechanisms leading to observed effects. It is the aim of the proposed work to answer many of the questions that remain unanswered and to test many hypotheses that, until now, remain untested. For example: what are the roles and relative importance of sputtering, nuclear and electronic energy deposition and over what range of energy do the various mechanisms contribute? Can effects be attributed to thermal spikes (heating), atomic displacements (damage), stress, surface and bulk diffusion, and modification of the local density of electron states? Why is it that in some cases the areal density of ion impacts correlates with that of features such as craters or asperities seen on the surface, and

in others only one in 40 impacts seem to have an effect, and what is the role of ion energy in this case? Until now only topographic features have been reported using either scanning tunneling microscopy (STM) or atomic force microscopy (AFM). The researchers propose to use the full range of SPM techniques including spectroscopy of the local density of states, tapping mode, magnetic probe, cleaved cross-sectioning of cascades in air, liquid and UHV.

Nothing has yet been reported on electron or laser effects. Many questions may be answered by a comparison of the different means of energy deposition in, and near, the surface of technologically interesting materials. They have started investigating electron bombardment and finding interesting differences between AFM and STM.

The group at The Chinese University of Hong Kong is ideally suited to make a strong contribution with excellent personnel and equipment including most SPM techniques, a Tandetron 4MeV accelerator and a pulsed beam high current, low energy surface treatment accelerator. (EE97005)

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**Photoelasticity Study of Stress Distribution in Semiconductors**

✉ WONG Sai Peng Joseph

☐ 1 October 1997

❖ Research Grants Council

Stresses are inevitably introduced in modern semiconductor device structures during the various processing steps such as oxidation, diffusion, implantation, etc. Many problems of defective devices in integrated circuits (IC) can be traced ultimately back to stresses that develop at the various stages of the IC processing. The properties and the stress states in many artificial semiconductor structures and novel optoelectronic device structures are closely related. It is obvious that investigation on the stress states in these structures is very important. The aims of this project include the setting up of an infrared photoelasticity (PE) measurement system with high spatial resolution and high sensitivity, to develop the PE method for the study of stress distribution in semiconductor structures, and to apply this method to the study of a number of specific semiconductor device structures. (CU97548)

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**Nano-Characterization and -Fabrication of Dielectrics and MIS Junctions on Silicon**

✉ XU Jianbin • WONG Sai Peng Joseph • CHEUNG Wing Yiu • WILSON Ian Howard • KWOK Wai Man Raymund (Chemistry)

☐ 1 November 1997

❖ Research Grants Council

In this project, the researchers propose to study the surface or interface electrical properties of silicon/dielectric layers and metal-insulator-silicon (MIS) junctions, and to fabricate nanostructures among them. The specific aims include:

- (1) Preparation of thin oxides, nitrides, oxynitrides, oxide-metal nanocomposites, and other dielectric layers on silicon by different methods.
- (2) Characterization and optimization of the thin films, and of the MIS junctions.
- (3) Nano-fabrication of the thin films. (CU97530)

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**Please refer to previous issues of this publication for more details of the following ongoing research at the department:**

<u>Edition</u>	<u>Title/Investigators</u>
1995-96	Fractal Image Coding with Adjacent Block Parameter Estimation (EE95019) ✉ CHAM Wai Kuen
1996-97	A DC Coefficient Restoration Scheme for Image Coding (EE96005) ✉ CHAM Wai Kuen
1995-96	Injection Oscillator Phase-locked Loop (CU94510) ✉ CHAN Cheong Fat • CHOY Chiu Sing Oliver
1995-96	A High Performance Microwave-to-Lightwave Modulator for Microwave Subcarrier Multiplexed Broadband Integrated Services Digital Networks (CU93506) ✉ CHAN Kam Tai • LAI Kin Yue Albert • HSU Chung Chi • YANG Shuwen*
1995-96	Theoretical Modelling and Experimental Study of Multisection Distributed Feedback Lasers for Advanced Lightwave Communications (EE94007) ✉ CHAN Kam Tai • LIEW So Kuen# • WANG Wei* • WANG Qi Ming* • EVANS Gary A.* • BUTLER Jerome*
1995-96	A Preamplified Acousto-Optic Tunable Filter for Dense Wavelength Division Multiplexed Networks (EE95015) ✉ CHAN Kam Tai
1996-97	Numerical Modelling and Experimental Studies of the Fiber Ring Laser for the

	Generation of Ultrashort Optical Pulses for Soliton Communication (EE96006) ✉ CHAN Kam Tai	1995-96	A Novel Meandering Inverted F Antenna (MIFA) for Mobile Communications (CU95506) ✉ LAI Kin Yue Albert
1995-96	Time-Domain Characterization, Modelling and Simulation of Nonuniform VLSI Interconnects (CU94539) ✉ CHANG Fung Yuel • WING Omar (Information Engineering)	1996-97	Mobile Radio Propagation Characterization and Prediction: A Neural Network Approach (EE96008) ✉ LAI Kin Yue Albert
1996-97	Study of Intermodulation Distortion in MMIC Active Filters (EE96004) ✉ CHENG Kwok Keung	1996-97	Analysis and Transcription Tool for Speech Research (EE96007) ✉ LEUNG Hong Chung
1995-96	Geolocation by Satellites (CU93508) ✉ CHING Pak Chung • CHAN Yiu Tong*	1995-96	III-V Based Ultrafast Metal-semiconductor-metal Photodetectors (CU95528) ✉ SHU Ching Tat C. • HSU Chung Chi • CHAN Kam Tai
1995-96	Speech Analysis by Visualized Representations Using Time-frequency Distributions (CU95505) ✉ CHING Pak Chung	1995-96	A Novel Scheme of Wavelength-Multiplexing Using Self-Injection Locked Lasers (EE95005) ✉ SHU Ching Tat C. • TSANG Hon Ki • ZHAO Yang*
1996-97	Blind Signal Estimation Using High Order Cumulants (EE96016) ✉ CHING Pak Chung	1995-96	Optoelectronic Waveguide Components for the Next Generation of Communication Systems (CU94511) ✉ TSANG Hon Ki • CHAN Kam Tai
1996-97	Development of an Automatic Recognition System for Continuous Cantonese Speech (CU96509) ✉ CHING Pak Chung	1995-96	Tapered Diode Lasers for the Generation of Long-Wavelength High-Power Optical Pulses (EE95016) ✉ TSANG Hon Ki
1996-97	Articulatory Controlled Speech Synthesis using Neural Networks (EE96002) ✉ CHING Pak Chung • GOODYEAR C. C.*	1995-96	Fabrication and Characterisation of Magnetic Thin Films on III-V Semiconductors (EE95006) ✉ TSANG Hon Ki • SCHWARZACHER Walther*
1989-90	Mechanism of Electron Transfer in Biological and Chemical Systems (BP84001) ✉ CHO Kar Cheong • CHOY Chung Loong (Physics) <sup>#</sup>	1996-97	Compact Ultrafast Semiconductor All-optical Switches and the Diode Laser and Erbium Doped Fiber Sources for Pumping Them (EE96009) ✉ TSANG Hon Ki
1995-96	An ICT Image Processing Chip based on Fast Computation Algorithm and Self-timed Circuit Technique (CU94507) ✉ CHOY Chiu Sing Oliver • CHAM Wai Kuen • CHAN Cheong Fat	1995-96	3-D Object Recognition by Active Vision Systems Using Belief Networks for Information Fusion (CU95518) ✉ TSUI Hung Tat
1995-96	An Adaptive Circuit Design Technique to Suppress Power Noise in a High Speed Output Driver (CU95526) ✉ CHOY Chiu Sing Oliver • CHAN Cheong Fat	1995-96	Epitaxial Growth of Compound Semiconductor Layers (EE95007) ✉ WILSON Ian Howard • BANGERT U.*
1996-97	Strained-layers Growth for Semiconductor Laser Applications (CU96551) ✉ HSU Chung Chi • XU Jianbin • HARK Sui Kong (Physics)		

- 1995-96 Metal Silicides by Ion Implantation with a MEVVA Ion Source (CU94520)  
✍ WONG Sai Peng Joseph • WILSON Ian Howard
- 1995-96 Ion Beam Synthesis and Modification of SiC/Si Heterostructures for Electronic Device Applications (CU95535)  
✍ WONG Sai Peng Joseph • WILSON Ian Howard
- 1996-97 Formation and Properties of Granular Structures by MEVVA Implantation (CU96534)  
✍ WONG Sai Peng Joseph • WILSON Ian Howard • WONG Hong Kuen (Physics)
- 1995-96 Investigation of Metal-oxide-semiconductor by Modified Scanning Probe Microscopy (EE95009)  
✍ XU Jianbin
- 1995-96 Investigations of Inorganic Ferroelectric Films by Scanning Probe Microscopy (CU95504)
- ✍ XU Jianbin • WONG Hong Kuen (Physics) • WILSON Ian Howard
- 1996-97 Development of Scanning Near Field Optical Microscopy and its Applications in Electronic Engineering (CU96512)  
✍ XU Jianbin • WONG Sai Peng Joseph • WILSON Ian Howard
- 1995-96 Electrical Bio-impedance Technique and Rheopneumography - Validation of the Modelling Method and Clinical Application (CU94545)  
✍ ZHANG Yuanting • CHOY Thomas T. C.# • CHAN Hok Sum (Medicine & Therapeutics) • XIONG J. F.\*
- 1995-96 Processing of Otoacoustic Emission Signals and Establishment of Its Homomorphic Simulation Model (EE95017)  
✍ ZHANG Yuanting • YANG Fu Sheng\* • YE Datien\*

## RESEARCH OUTPUTS AND PUBLICATIONS

- <P953633> **Tsui, Hung Tat and Chen Zhi Yi.** "A New Tracking Method for Shape from Motion Using an Active Vision System". *Second Asian Conference on Computer Vision, December (ACCV'95) Singapore* vol.2, pp.689-693. Singapore: IEEE Singapore Section, 1995.12.
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- <P964114> **Anh, Vo; Fabrice Gras and Hung Tat Tsui.** "Fractal Segmentation Using Multiresolution B-Spline Wavelets". Paper presented in the 4th International Symposium on Signal Processing and Its Applications. Brisbane, Australia, 1996.08.

- <P964115> **Tian, Ying-Li and H.T. Tsui.** "3D Shape Recovery from Two-Color Image Sequences Using a Genetic Algorithm". *Abstracts of the 13th International Conference of Pattern Recognition (ICPR'96)* vol.4, pp.674-678. Vienna: IEEE Computer Society Press, 1996.08.
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- <P964128> **Zheng, L.; F.S. Yang; D.T. Ye and Y.T. Zhang.** "Cochlea Modeling in Regard to Otoacoustic Emissions". *Proceedings of International Conference on Biomedical Engineering (Technology for Health)* pp.50-53. Hong Kong, 1996.06.
- <P964138> **Gao, X.R.; Miller A.G. and Zhang Y.T.** "Non-Invasive Diagnosis of Lung Diseases Detected During Percussion". *Proceedings of International Conference on Biomedical Engineering (Technology for Health)* pp.24-27. Hong Kong, 1996.06.
- <P964141> **Miller, A.G. and Zhang Y.T.** "Pulmonary Condition Monitoring Using Percussion: A Time Frequency Approach". *Proceedings of International Conference on Biomedical Engineering (Technology for Health)* pp.279-282. Hong Kong, 1996.06.
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see also <P964137>, <P973540>, <P973766>, <P980412>, <P980839>, <P981038>

## RESEARCH PROJECTS

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### Surveillance Schemes for Passive Branched Optical Networks with Erbium-Doped Fiber Amplifiers

- ✉ CHEN Lian Kuan • TONG Fuk Kay  
□ 15 September 1997  
❖ Research Grants Council

The researchers propose a novel passive surveillance scheme for fault identification on optically-amplified branched networks using fiber Bragg gratings (FBG). The residual amplified spontaneous emission (ASE) power of EDFA will be used as the monitoring light source, thus no extra light source is required. The link quality of multiple fiber branches and the operation status of EDFA's will be *constantly* and *simultaneously* monitored without suspending in-service channels. Progressive degradation of fiber due to cable bending or deformation can be detected as well by monitoring the reflected power level. (CU97533)

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### High Speed Multimedia Optical Network Prototype

- ✉ CHEUNG Kwok Wai • CHEN Lian Kuan  
□ 1 January 1998  
❖ Research Grants Council

The researchers propose to develop a 4-node, 2.5 Gb/s high-speed multimedia network prototype based on the Adaptive Cycle Tunable Access (ACTA) protocol. The protocol has been demonstrated to be a very simple and efficient multi-channel bus/ring network protocol suitable for high speed integrated network implementation. It adopts a slotted cycle format to transmit fixed size packets in which the cycle lengths are adaptively varied according to the network load. Only two control bits per-slot are required in the media access, thus it can be made slot compatible to ATM. A 3-node, 100-Mb/s multimedia network prototype based on the ACTA protocol has been successfully demonstrated in the CUM LAUDE NET project previously under the Chinese University funding. The current project aims at resolving difficulties that would only occur in the higher speed regime, including high speed network interface design, efficient protocol layering and implementation, operating system support, and efficient implementation of flow control algorithms at the high transmission rate. It is believed that these practical problems can only be understood properly through the actual implementation of a prototype. Owing to a significant reduction of the requested funding, only a paper design will be carried out in this project. (CU97563)

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### Effects of Crosstalk in Wavelength-Division-Multiplexing (WDM) Systems

- ✉ HO Keang Po Ricky  
□ 1 October 1997  
❖ CUHK Research Committee Funding

The basis of future information infrastructure will be built upon multi-wavelength optical networks in which wavelength-division-multiplexing (WDM) signal is transmitted in fiber links, channel routing and add-drop functions are performed by wavelength routers. The fundamental design difficulty of optical networks is the crosstalk induced by insufficient rejection in WDM demultiplexer and the homodyne crosstalk from neighboring inputs, causing severe degradation in system performance.

Better filtering can eliminate the crosstalk induced by insufficient rejection. However, the crosstalk rejection requirement need to be studied carefully, especially for hybrid WDM system having various type of digital and analog channels. Having similar or identical wavelength to that of the signal, homodyne crosstalk is difficult to be eliminated by filtering, which will beat with the signal and generate a new kind of noise at the receiver. Previous analyses on homodyne crosstalk in wavelength routers were largely based on Gaussian approximation, though there were reports and evidences that this assumption is incorrect. The Gaussian assumption is only valid for a large number of identical and independent interference sources. But in most cases, the number of dominant of dominant interference source is limited to one or two due to near-far effect in the network.

The researchers would like to study the crosstalk rejection requirements for WDM system and to develop a better non-Gaussian mathematical model to analyze homodyne crosstalk. All studies will be based on exact mathematical analysis and then verified by experimental measurements. (EE97006)

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### Dynamic Routing and Traffic Management for ATM Networks

- ✉ HUI Yu Ngai  
□ 1 September 1997  
❖ Research Grants Council

This research aims at the theoretical and experimental study of routing and traffic management for networks of ATM switches. While routing for data and telephone networks is well understood, routing of multimedia connections for maintaining good Quality of Service (QoS) requires new concepts of bandwidth provisioning and criteria for evaluating alternative routes. Using the notion of Effective Bandwidth, the

researcher will evaluate various routing mechanisms for their effectiveness in meeting social and individual objectives. The stability of these algorithms will be evaluated theoretically and by simulation.

The theoretical framework will be applied to Internet Exchanges. Novel routing algorithms will be implemented using Route Arbiters (RA). Traffic statistics on the ATM network will be collected for analysis and network management. These studies will provide much needed knowledge for allowing multimedia applications on Internet Exchanges.

(CU97536)

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**The Principle of Multi-dimensional Switching and Its Applications in High-speed ATM Packet Switches**

✉ LEE Tony Tong

☐ 1 September 1997

❖ Research Grants Council

With the advent of optical communications technology, trunk transmission speed has increased tremendously over the past few years. In order to keep up with the advancement in transmission technology, the challenge is to design switches which are high-speed, scalable, of lower complexity and easily manageable. To achieve this goal, the researcher proposes the principle of multi-dimensional switching for ATM switches. In multi-dimensional switching, each source or destination port is coded with a multi-dimensional address, which is essentially an address consisting of a number of components (or dimensions). To go from a source to a destination, a packet is routed through a number of switching stages. In each step of its journey, the packet is routed to different dimensions according to the information in the routing tag. As long as the paths taken by different packets are non-overlapping, no internal conflicts will occur. The assignment of non-overlapping paths to the packets can be done by a distributed algorithm. The concept is similar to the use of non-overlapping wavelength channels in Wavelength-Division Multiplexing (WDM). The use of multi-dimensional switching leads to ATM switch architectures which are modular, scalable and with reduced complexity. As a first step, he demonstrates the idea by applying a 2-dimensional switching scheme to the shuffle-exchange network. The resulting two-dimensional shuffle-exchange network has both the non-blocking and self-routing properties. Compared with the switch based on the sort-banyan architecture, the switch constructed from the two-dimensional shuffle-exchange network has a reduced hardware complexity. For switch size up to 10,000 x 10,000, it shows that a saving of 26.94% of the number of comparators in the sorting networks can be achieved. Moreover, the time required to execute the contention resolution algorithm is much

reduced. In future research, he plans to generalize the principle to be applicable to arbitrary number of dimensions and to provide a unified theory for characterizing and implementing the principle. It is envisioned that the multi-dimensional switching principle is compatible with the traditional space, time and even wavelength division multiplexing, making the principle more useful and practical.

(CU97570)

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**Lossless Transmission of Multiple Video Streams**

✉ LIEW Soung Chang

☐ 1 January 1998

❖ Research Grants Council

This project investigates a new concept for the transmission of video information called *lossless aggregation*. It is a scheme for the delivery of VBR (variable bit-rate) video streams from a video server to a group of users over a shared communication channel, a setting which is common in the video broadcast and video-on-demand services. The preliminary investigation indicates that very significant receiver-buffer reduction can be achieved with aggregation compared with independent transmission of individual video streams over separate channels. A detailed plan for a thorough study has been formulated. In particular, two outcomes expected are (1) lower-cost receiver equipment and (2) efficient dynamic bandwidth allocation schemes that can be used in many practical video delivery services.

(CU97532)

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**Signal Processing Techniques in Spread Spectrum Systems with Adaptive Antenna Arrays**

✉ LOK Tat Ming

☐ 1 October 1997

❖ CUHK Research Committee Funding

Direct sequence spread spectrum multiple access (DS/SSMA) systems have been proposed for future generation cellular systems and personal communication systems (PCS). To exploit the advantages of spread spectrum signaling, signal processing techniques have to be applied. Efficient signal processing techniques can be used to reduce multiple access interference (MAI), as well as other forms of interference. When efficient signal processing techniques are coupled with adaptive antenna arrays, interference coming from directions different from that of the desired user can actually be nullified. Therefore, the interference rejection capability of a DS/SSMA system is improved, and the capacity of the system is increased. Actually, reports show that huge improvement in error performance, and hence capacity, is possible with

suitable signal processing techniques and antenna arrays.

Recently, Wong, Lok (the principal investigator of this proposal), Lehnert, and Zoltowski have proposed an adaptive receiver for DS/SSMA systems. The receiver can work with or without antenna arrays. Preliminary studies showed that dramatic improvement in performance could be obtained. However, many issues remain to be considered. The goals of the research in this proposal are to investigate equalisation, synchronization, and multiuser detection with adaptive antenna arrays, to evaluate the performance of the receiver under different channel environments, and to develop simple and stable algorithms suitable for hardware implementation. It is anticipated that the research in this proposal would impact the research on signal processing techniques in communications, as well as the development and the implementation of future generation wireless communication systems. (EE97007)

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#### **Preliminary Study of Image Compression by Automatic Recognition**

✉ TANG Xiaou

□ 10 February 1998

❖ CUHK Research Committee Funding

The efficient digital representation or coding of image and video signals has been the subject of considerable research over the past few decades. A major objective of image coding is to represent an image with as few bits as possible while preserving the level of quality and intelligibility for the given application. In this research, the researcher proposes a high compression ratio image coding system utilizing intelligent information offered by an image classification system. By introducing pattern recognition into an image coding system we will be able to adaptively adjust the coding strategy according to what is present in the current image. The researchers hope to derive quantitative relations between the classification system output and the coding system parameters in order to achieve high compression ratio without sacrificing much intelligibility of the decoded image. Such an intelligent image compression system can be extremely useful in a number of areas, including remote sensing, underwater environmental surveying and monitoring using autonomous vehicles, and robotic operation using telepresence. More generic aspects of the algorithm are also beneficial for such applications as multimedia communication. (CS97014)

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#### **Component Surveillance and Error Detection in Multi-Wavelength Networks**

✉ TONG Fuk Kay • MARZ Reinhard\*

□ 1 May 1998

❖ Germany/Hong Kong Joint Research Scheme

All optical multi-wavelength routing network is the most viable approach to fully exploit the enormous bandwidth available in the fiber. Already, there are plans to install submarine cables linking US to various Asian countries with multi-wavelength configuration, with each fiber carrying four wavelengths and each wavelength channel is modulated at 2.5 Gbps. The transmission can be upgraded to eight-wavelength system. In order to realize a fully functional and practical network, each of the network components has to be continuously monitored, and detect any errors that may have generated in the signaling process. While there are plenty of success on the development networking components, such as those for the wavelength routing, optical cross-connect, etc., few focuses on the surveillance, robustness, and reconfigurability issues. The primary project goal is to provide novel surveillance schemes for various critical components in the all-optical network. Transport and conformance of the surveillance information to the existing standard will also be studied. (EE97015)

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#### **Theoretical Study of Partitioning Techniques for Iterative Methods in Circuit Simulation**

✉ WING Omar • LUK Wai Shing (Computer Science & Engineering)

□ 1 December 1997

❖ Research Grants Council

The researchers propose to develop a theoretical understanding of the convergence properties of iterative methods applied to partitioned VLSI circuits. They have in mind the suite of Krylov subspace methods extended to function space and their approach will be based on the spectral theory of linear operators. Developing this theory will involve studying the following questions: (1) whether a circuit (operator) that is refractory to iterative methods may be partitioned into subcircuits (operators) for which iterative methods converge successfully; (2) whether there is a spectral relation between the convergence properties of partitioned and non-partitioned (entire) circuits (operators) and how they may be related; and (3) whether there exists an optimal partition insofar as the rate of convergence of the iterative solution is concerned. Their goal is to provide a theoretical foundation to support the development of a robust and reliable circuit simulator for parallel computation. (CU97540)

**Wireless ATM: Issues in Multi-Rate Multiple Access**

✉ WONG Wing Shing • HUI Yu Ngai  
 □ 1 September 1997  
 ❖ Research Grants Council

Wireless ATM has received a lot of attentions lately in the communication research communities due partly to the growing popularization of multimedia services and mobile communication services. Another important factor is the rapid technological advance that eventually brings many aspects of the wireless ATM concept close to reality. A wireless ATM system is extremely complicated, involving issues ranging from physical and MAC layer design to mobility management, to routing and traffic management. In this project, the focus is on the multiple access problem, one of key issues in wireless ATM. Our approach differs from many of the published work in that our focus is on designing and analyzing multiple access protocols that can be implemented on top of third generation wireless standard, such as the DECT.

There are three major tasks in this proposal:

- (1) Modify a recently proposed multiple access algorithm, Predictive Queueing Multiple Access (PQMA) so that it can be implemented on top of a third generation wireless system such as DECT.
- (2) Investigate the time-slot scheduling problem at a base station.
- (3) Investigate an integrated power control and multi-rate service problem.  
 (CU97538)

**Please refer to previous issues of this publication for more details of the following ongoing research at the department:**

<u>Edition</u>	<u>Title/Investigators</u>
1995-96	A Novel and Feasible Approach to Realize a High Speed Optical TDM Network (CU95541) ✉ CHEN Lian Kuan • CHEUNG Kwok Wai
1996-97	Fiber-based Components for Ultra-high Speed Optical Networks (CU96525) ✉ CHEN Lian Kuan • CHEUNG Kwok Wai • JIAN Shuisheng*
1995-96	Burst-mode Receiver Design, Analysis and Applications (CU95540) ✉ CHEUNG Kwok Wai • CHEN Lian Kuan
1995-96	High Capacity Network Infrastructures for Internet Service Providers and Multimedia Applications (CS95027)

	✉ HUI Yu Ngai • CHEUNG Kwok Wai • CHENG Che Hoo
1995-96	The Fundamental Issues of Design and Analysis of High-speed Packet Switched Networks (CU94541) ✉ LEE Tony Tong • LIEW Soung Chang
1996-97	Path Switching - A Quasi-Static Routing Scheme for Large-Scale ATM Packet Switches (CU96523) ✉ LEE Tony Tong
1995-96	Prototyping Large ATM Switches of a 3-CMOS-chip Design (CU95508) ✉ LI Shuo-yen Robert • CHAN Cheong Fat (Electronic Engineering)
1993-94	Throughput Optimization in Multistage ATM Switches (EE93010) ✉ LIEW Soung Chang
1995-96	Conceptual Study and Implementation of a Parallel Routing Scheme on an ATM Network Testbed (CU94533) ✉ LIEW Soung Chang • LEE Tony Tong
1995-96	Video Aggregation: Integration of Video Data Compression and Multiplexing for Transport in Broadband Communication Networks (CU95502) ✉ LIEW Soung Chang
1996-97	Control-Theoretic Approach to Adaptation of VBR Compressed Video for Transport over a CBR Communications Channel (CU96506) ✉ LIEW Soung Chang
1996-97	Design and Analysis of Multicarrier CDMA Systems for Wireless Communications (EE96017) ✉ LOK Tat Ming
1996-97	Reducing the Pre-Switching Processing Complexity in Multistage ATM Switching Networks (CS96022) ✉ TO Pak Tung
1995-96	Data Compression: Theory, General Applications, and Chinese Applications (CU95524) ✉ WEI Keh Wei Victor
1996-97	Information Security in Communication and Computing Networks (CU96526) ✉ WEI Keh Wei Victor

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|---------|--|---------|--|
| 1995-96 | Information Coding in Decision and Control Systems (CU95507)<br>✉ WONG Wing Shing  | 1996-97 | New Approaches to Mobility Management and Multiple Access Protocol for Cellular Systems (CU96524)<br>✉ WONG Wing Shing |
| 1996-97 | Integrating Data Services on DECT Systems (EE96001)<br>✉ WONG Wing Shing • CHAN Kam Tai (Electronic Engineering) • YUM Peter Tak Shing | 1996-97 | Multilevel Diversity Coding (CU96501)<br>✉ YEUNG Wai Ho Raymond • ZHANG Zhen*  |

## RESEARCH OUTPUTS AND PUBLICATIONS

- <P964045> **Tong, F.; R. Ramaswami.** <IBM T.J. Watson 研究中心所進行之光纖網路研究>. 《光訊》第 62 期, 頁 5-9. 台灣, 1996.10.30.
- <P971719> **Lee, Tony T.; Soung C. Liew and Quan-Long Ding.** "Parallel Communications for ATM Network Control and Management". *Performance Evaluation* vol.705, pp.1-22. 1997.
- <P972253> **Zhang, Zhen; En-Hui Yang and Victor K. Wei.** "The Redundancy of Source Coding with a Fidelity Criterion-Part One: Known Statistics". *IEEE Transactions on Information Theory* vol.43, pp.71-91. 1997.01.
- <P972861> **Wong, Eric W.M. and Tak-Shing Peter Yum.** "Delay Bounds for Packet Satellite Protocols". *Telecommunication Systems* vol.8, pp.277-291. USA, 1997.11.
- <P973233> **Wing, O.** "On the Digital Classroom". *Forum Proceedings of 1st Asia-Pacific Forum on Engineering and Technology Education* vol.1, pp.93-95. Monash, Australia: UNESCO Supported International Centre for Engineering Education, Monash University, 1997.07.06.
- <P973234> **Jiang, Yao-Lin and Omar Wing.** "Splitting Techniques to Speed Up the Convergence of Waveform Relaxation Methods for Tightly Coupled Circuit Systems". *Proceedings of European Conference on Circuit Theory and Design* pp.1054-1058. Budapest, Hungary: European Circuits and Systems Council, 1997.09.01.
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see also <P964046>, <P972686>, <P972687>, <P973782>, <P974444>, <P974445>, <P981780>, <P982467>

## RESEARCH PROJECTS

### Stereo Vision and Motion Analysis in Complement Using SVD

- ✍ CHUNG Chi Kit Ronald
- ☐ 1 December 1997
- ❖ Research Grants Council

This project studies how two vision cues: stereo vision and visual motion analysis, can be combined to complement each other in recovering 3D information of the imaged scene. In constructing such a stereo-motion cue, the followings will be emphasized:

- (1) It should work with relatively short image sequences.
- (2) It should take into account possible disturbances to and uncertainty in the camera motion.
- (3) Most importantly, it should have an explicit mechanism to combine the advantages of the motion and stereo cues to provide easy correspondence as well as accurate reconstruction.

(CU97507)

### An Efficient Iterative Approach to Computing Nonlinear $H^\infty$ Control Laws

- ✍ HUANG Jie
- ☐ 1 December 1997
- ❖ Research Grants Council

This research project aims to develop an efficient iterative algorithm for approximately computing nonlinear  $H^\infty$  control laws. The design of a non-linear (state feedback)  $H^\infty$  control law boils down to solving the Hamilton-Jacobi-Isaacs (HJI) equation, an extension of the algebraic Riccati equations in the linear  $H^\infty$  problem. Due to the nonlinear nature, it is almost impossible to obtain the approximate solution of the HJI equations. Therefore, the practical way is to find the approximate solution of the HJI equation in terms of the Taylor series form. This approximation leads to a sequence of linear algebraic equations that governs the coefficients of the Taylor series. Solving these equations with classic approaches such as Gaussian elimination method would consume enormous computations, thus not practically feasible. This project proposes an efficient iterative approach to solving this sequence of equations that may increase the computational efficiency more than 10 times over non-iterative approaches, and, at the same time, offer superior numerical stability property. This proposal is the first-ever effort for developing an efficient iterative procedure to approximately solve the HJI equation. Success of our approach may make the nonlinear  $H^\infty$  control a feasible practical design tool.

Moreover, the iterative nature of this approach lends itself to an efficient implementation of the algorithm in routing computer languages and software packages, which can be used to facilitate a variety of practical control systems designs, and reduce the design period and development costs, thus significantly enhancing the competitiveness of Hong Kong in high-tech area. (CU97508)

### Interacting with a Virtually Deformable Object with an Instrumented Glove

- ✍ HUI Kin Chuen
- ☐ 1 September 1997
- ❖ Research Grants Council

One of the major concern in the field of virtual reality is to have fast and efficient means for a human to interact with objects in a virtual environment. The use of an instrumented glove provides the possibility of interacting with a virtual object directly. However, existing approaches mainly concentrate on the interactions with rigid objects. A common approach is to simplify the problem by approximating both the hand and the object with enclosing boxes or spheres so that the human actually interacts with the enclosing boxes or spheres. Besides, a set of predefined motions such as point, reach, and grab are usually used for the interaction. The problems of interacting with a virtual object, in particular a deformable object, with the dexterous motion of the hand and fingers remain not well understood.

This project aims at developing the basic tools for manipulating a virtually deformable object with an instrumented glove. This include developing a representation scheme that allows shape changes to be modelled efficiently. In order to obtain interactive response, fast algorithms will be developed for detecting collisions between the object and the virtual hand. Algorithms for evaluating the response (i.e. motion, deformation) of the object while interacting with the glove will also be developed.

(CU97542)

### Real Intelligence Map: Theoretical Study and Hardware Implementation

- ✍ KWONG Chung Ping
- ☐ 1 August 1997
- ❖ Research Grants Council

Recently *Fuzzy logic* has found its extensive applications in a wide range of consumer/industrial products, with an aim of improving their performance and increasing the degree of automation. This is achieved, as the principle of the method, by translating the human "intelligence" into computing algorithms that can be realized by electronic circuits. The fundamental assumption of fuzzy logic is that

human beings make their decisions based on vague (fuzzy), linguistic type of information. Fuzzy logic uses a three-step procedure to realize this translation, namely, fuzzification, fuzzy inference, and defuzzification. However, the researchers argue that the fuzzy approach is neither essential nor effective in many situations. Instead, they will propose a new model (named "Real Intelligence Map (RIM)") of representing the human inference process. The new model not only provides theoretical insights to the grand problem of realizing human intelligence on machines, but its simpler structure (compared with the fuzzy logic) also reduces the cost of implementation when the model is applied to real applications.  
(CU97545)

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### Intelligent Mechanical Structures

- ✉ LI Wen Jung
- 1 November 1997
- ❖ CUHK Research Committee Funding

Some of the proposed applications for Micro Electro Mechanical Systems (MEMS or micromachines) include the creation of intelligent macro mechanical structures that can perceive physical information from their surroundings and react accordingly. For example, MEMS skin-friction sensors, turbulence-control actuators, and decision-making circuitry can now be built simultaneously using the integrated circuit (IC) technology. Plans are underway to integrate such systems onto the wings of US fighter and commercial planes. However, conventional IC technology allows fabrication of micro devices only on flat substrates, which limits the potential production of intelligent macro mechanical structures with non-planar surfaces. This project proposes to use the direct-write method to fabricate MEMS devices onto non-planar substrates. Issues concerning the mapping of 2D IC/MEMS designs onto 3D curved surfaces will be examined. Algorithm for integrating the existing commercial MEMS/IC/CAD software and hardware tools will be defined. Control schemes for moving substrates of general surface curvature in a direct-write system will be developed. A new commercial industry can be potentially created by this research. Intelligent mechanical structures can be used to produce rotation-rate sensors for manufacturing equipment, multidirectional force sensors for robots and vehicles, and biomedical devices for surgery and medical implantation.  
(EE97010)

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### Smart Dampers for Train Suspension Systems

- ✉ LIAO Wei Hsin • XU Yangsheng
- 1 October 1997
- ❖ CUHK Research Committee Funding

Ride quality is concerned with the sensation or feel of the passenger in the environment of a moving train. Ride comfort problems mainly arise from lateral and transverse vibrations of the train body. The objective of this study is to develop novel suspension systems for the vibration control of the train so that the passenger's sensation of comfort will be improved. A magneto-rheological (MR) fluid comprises a fluid that is able to turn solid nearly instantly when brought near a strong magnet. When the magnet is taken away it completely reverts back into liquid. This controllable change of state with some desirable features such as high strength, good stability, broad operational temperature range, and fast response time give rise to industrial applications. MR fluids show great potential in applications ranging from shock absorbers and engine dampers for cars, robotic joint controls, to brakes in exercise equipment. In this project, the researchers are interested in understanding the physics of this type of smart material and its applications in train vibration controls. They will study the field-induced microstructures, the mechanisms of the formation of these structures from both theoretical and experimental perspectives. They will also develop control algorithms for train suspension systems with MR fluid dampers.  
(EE97009)

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### Optimization of Active-Passive Hybrid Structural Control

- ✉ LIAO Wei Hsin
- 1 June 1998
- ❖ CUHK Research Committee Funding

This research will investigate an enhanced active constrained layer (EACL) damping treatment, which consists of viscoelastic materials (VEM) sandwiched between the main structure and an active piezoelectric coversheet with edge elements. The use of active-passive hybrid structural control aims to achieve maximum benefits from its active and passive actions. Based on a through system dynamics analysis, fundamental understanding of the actuators' behavior has been developed. An optimization of the EACL system will be studied. Variable parameters, such as equivalent stiffness of edge elements, position and length of the actuator patch, thickness and Young's modulus of the piezoelectric material, and thickness and material properties of VEM could be optimally synthesized via simultaneous active and passive control design.  
(PS97026)

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**Mapping Human Hand Motion to Robotic Hands: Learning and Optimizing**

✉ LIU Yun Hui

□ 1 September 1997

❖ Research Grants Council

This research aims to develop a friendly task-teaching interface with the abilities of learning demonstrated human motion and optimizing the learned model in dextrous manipulation tasks automatically for multi-fingered robotic hands.

The high dexterity of robotic hands and the geometric and mechanical constraints in dextrous manipulation tasks make their task teaching difficult. Existing teaching systems by demonstration for assembly and grasping are not applicable to generating dextrous motion because they are only based on geometric understanding of human motion. The lack of learning ability from different teachings is another point to be improved in the systems. In this proposal, the researcher will develop an algorithm for generating a program called skill from dextrous motion taught by human operators through a data glove. The taught motion will be segmented into elemental motions, such as grasping, sliding, rolling and their combinations. To improve the skill from different teachings, a learning algorithm will be designed based on both dynamic simulations (in a virtual reality (VR) environment) and task execution on real hand systems. Furthermore, to refine the learned skill, an automatic optimization procedure will be introduced in its neighborhood. The success of this project will provide not only a human friendly teaching system but also solutions to mapping human skill to robot systems and thus enhance the usage and productivity of robots.

(CU97544)

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**Multilayer Recurrent Neural Networks for Real-time Synthesizing and Optimizing Robust Linear and Nonlinear Control Systems**

✉ WANG Jun • HUANG Jie

□ 1 December 1997

❖ Research Grants Council

In conventional approaches, the controller parameters such as feedback gains are usually determined through off-line computation. For a time-varying or uncertain linear/nonlinear system, the system performance varies and desired design criteria even the system stability cannot be guaranteed with off-line computed controller parameters. To ensure system stability and other design criteria, a robust controller with auto-tuning capability is not only desirable but also necessary. In this project, multilayer recurrent neural networks will be developed for synthesizing and optimizing robust

linear and nonlinear control systems in terms of both transient and steady-state errors. Four major tasks are identified: (1) the adoption of appropriate robustness measures that improve both transient and steady-state performance, (2) the development of multilayer recurrent neural networks capable of autonomously synthesizing and tuning controllers with optimized robustness measures, (3) the analysis of the overall system dynamics in terms of stability, optimality, realizability, applicability, etc., (4) the evaluation of the system performance by means of numerical simulations.

(CU97543)

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**A Human-Machine Interface that Learns**

✉ XU Yangsheng • NECHYBA Michael<sup>#</sup>

□ 1 October 1997

❖ CUHK Research Committee Funding

The researchers propose to develop a human-machine interface that can learn. The fundamental problem here is modeling and transferring human control strategy (HCS) in response to real-time inputs. The problem has significant impact in a variety of applications such as space telerobotics, the Intelligent Vehicle Highway System (IVHS), real-time training and simulation, and agile manufacturing. The proposed research provides a framework for abstracting human skills so as to facilitate analysis of human control, to develop human-like intelligent machines, to allow robots to learn from human partners in human-robot coordination, and to transfer skill from human to human through learning human-machine interfaces. They will address the following issues: (1) how to efficiently model human control strategy, (2) how to select state inputs in order to generate reliable models, (3) how to validate the computed models, (4) how to evaluate the quality of the HCS models, (5) how to optimize performance of the HCS models, and (6) how to effectively transfer human control strategy.

(CS97008)

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**Satellite Servicing Robot**

✉ XU Yangsheng • ZHANG Jiong\*

□ 1 April 1998

❖ Croucher Foundation Visitorship for PRC Scholars

The researchers focus on the technology of catching a moving object in unknown space environment. The research can be further decomposed into three components:

- (1) Modeling of the dynamic coupling between a space vehicle and space robots and searching for the optimum criterion in selecting robot catching motion.

- (2) Planning robot motion in catching the moving object with minimal effect on the space vehicle's attitude control.
- (3) Real-time identification of a moving object through vision systems on-board, and vision-based catching implementation.

(EE97018)

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### Singular Value-Based Fuzzy Identification

- ✉ YAM Yeung
- ☐ 1 November 1997
- ❖ Research Grants Council

Identification of a fuzzy system is normally divided into identifying the membership functions, the rule consequents, and the inference paradigm. The three parts are in general inter-related to each other which makes the problem difficult. Most of the previous works in this area consider the three parts of the fuzzy identification as essentially independent, and leading to less effective system representation. The present project proposes to pursue the issue by conducting the three parts of fuzzy identification simultaneously. The proposed method is based on Singular Value Decomposition (SVD). Preliminary works by the researcher have shown that SVD method is effective in generating fuzzy approximator for a given function using sampled outputs over a set of rectangular input grid points. These results will be extended in the proposed project to the identification of fuzzy system using randomly sampled and noisy data. Extensions towards using other types of fuzzy inferences (e.g. Min-Max-Gravity rule) and incorporating possible missing rules will also be investigated.

(CU97531)

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### A Reduction Procedure for Neural Networks

- ✉ YAM Yeung
- ☐ 1 December 1997
- ❖ CUHK Research Committee Funding

This project addresses the following problem: given a neural network of certain size, what is a formal way to pick a reduced number of nodes and to determine the corresponding weightings so as to maintain a certain performance according to some defined measure? The advantage of neural networks lies in the fact that, with sufficient number of nodes and weightings assigned, they can be adapted to yield close fitting of any given set of data. However, a standard method to assign the structure of a neural network is still lacking, and there's no formal way yet to check whether a neural network does contain hidden redundancies, or that some nodes may have only minimal effects on the overall performance. In linear systems, these issues are handled by the

principal component analysis, which applies singular value decomposition to the system models. This project proposes to develop a similar tool for neural networks. By establishing a rigorous methodology to gauge the importance of the nodes and weightings of a neural network, a more condensed version containing the most important nodes can be extracted from the given neural network. In the case when there are more than one neural networks of different sizes but based on the same set of training data, the method would establish a formulation to consolidate and include the most essential information common to all, thereby eliminating any subjective judgement and ambiguity in the sizing of the networks. This proposed topic is an offshoot of a singular value-based approach for the reduction of fuzzy systems. The proposed work adopts the following perspective for the sizing problem of neural network: though the researchers do not yet know the best assignment for a neural network, they should at least have a procedure to streamline the resulting product generated based on heuristic assignment.

The pay-off and significance of the proposed project include:

- (1) The project aims at getting at the essence, or the core, of a neural network. This relates to what constitutes as the "essential" portion in the network.
- (2) While there's no formal approach for assigning the structure of a neural network, the project produces a standard procedures to extract the important component and eliminating possible redundancy and subjective judgement embedded in the initial assignment.
- (3) The proposed work provides a tradeoff strategy between the fitting accuracy and the size of a neural network. This is useful if one is interested in a neural network of reduced complexity and is willing to give up some of the accuracy in fitting of the training data.

(EE97011)

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### Micro-Electro-Mechanical System Tactile Sensor Array for Haptic Application

- ✉ YEUNG Siu Kau • YATES Rob\*
- ☐ 15 April 1998
- ❖ UK/Hong Kong Joint Research Scheme, the British Council

Micro-fabrication technology has made exciting strides over the past decade, both by spawning the emerging multi-disciplinary technology of micromechatronics, and by continuous enhancements to semiconductor microelectronics fabrication techniques.

Research groups around the world (Japan, USA, Europe) devote enormous resources to these technologies. Billion dollar markets exist already in Micro-electro-Mechanical Systems (MEMS), and

micromachined devices have been successfully implemented in many consumer products. Further, the United States has identified MEMS as a strategic R&D area. Already there is substantial awareness and interest in MEMS in Hong Kong.

The University of Science and Technology of Hong Kong has initiated research on MEMS since 1995 and the completion of their fabrication laboratory is in the final stage. The Chinese University of Hong Kong (CUHK) researchers (collaboration between the Department of Mechanical and Automation Engineering and Electronic Engineering) have come together to take up the challenge to initiate and establish a MEMS laboratory on top of the existing semiconductor processing laboratory which has been operated for teaching and research for many years.

Micromechatronics applies microfabrication techniques to realize very creative microscopic devices and systems. These devices have often been integrated with potentially very complex devices and systems. These devices have often been integrated with potentially very complex microelectronic circuitry, to produce intelligent devices, such as smart sensors and actuators. This field currently enjoys commercial success in the form of microsensors and microactuators (subminiature accelerometers, gyroscopes, physical and chemical sensors, and biomedical sensors). Area of application envisaged are in the areas where enhancement of Hong Kong industries can be applied. The list of applications where the researchers at the CUHK will pursue are as follows: automobiles/vehicle systems, environmental condition monitoring and control, robotics, manufacturing automation, aerospace and biomedical sensors and actuators.

Microelectronics and integrated Circuit Processing includes a broad category of design, fabrication, and characterization of miniature integrated circuits on semiconductor substrates, forming the basis for consumer electronics and VLAI. CUHK research in microelectronics processing focuses in novel processes for advanced industrial integrated circuit fabrication. It is therefore proposed to establish MEMS laboratory by enhancement and modification of the existing EE electronic fabrication laboratory. The success of the founding MEMS laboratory will offer the opportunity to create activities in advanced technology development in Hong Kong. (EE97017)

**Please refer to previous issues of this publication for more details of the following ongoing research at the department:**

Edition      Title/Investigators

1995-96      Using 2-D Invariants for 3-D Object Recognition (CU94506)  
 ✉ CHUNG Chi Kit Ronald

1996-97      Three-Dimensional Reconstruction from Stereo-Motion (CS96009)  
 ✉ CHUNG Chi Kit Ronald

1995-96      Numerical Approach to Computing Non-linear  $H_\infty$  Control Laws (EE95013)  
 ✉ HUANG Jie

1996-97      Robust Control of Nonminimum Phase Nonlinear Systems (CU96518)  
 ✉ HUANG Jie

1995-96      Decentralized Hybrid Cooperation Control of Multiple Manipulators (EE95018)  
 ✉ LIU Yun Hui

1996-97      Decentralized Adaptive Control for Multiple Manipulators in Cooperation (EE96012)  
 ✉ LIU Yun Hui

1995-96      Recurrent Neural Networks for Manipulator Inverse Kinematics Computation of Redundant Robots (EE95012)  
 ✉ WANG Jun

1996-97      Recurrent Neural Networks for Solving Combinatorial Optimization Problems with Time-Varying Parameters and Their Applications for En-Route Vehicle Guidance in Intelligent Transportation Systems (CU96521)  
 ✉ WANG Jun

1996-97      Hidden Markov Model Approach to Monitoring Spot Welding Quality (EE96013)  
 ✉ XU Yangsheng • ZHANG Jiong\*

1993-94      A Next-Generation Intelligent Robot with Creativity (EE94001)  
 ✉ YAM Yeung • SHI Xiaolun# • HUI Kin Chuen • CHUNG Chi Kit Ronald • KWONG Chung Ping

1995-96      Integrated Approach for Robust Control Design (CU93511)  
 ✉ YAM Yeung

1995-96      Manipulator Control for Soft Contact Applications Using Neuro-fuzzy Techniques and Non-parametric Models (CU95539)  
 ✉ YAM Yeung • KWONG Chung Ping

1996-97      Identification of Fuzzy System via Singular Value-based Methods (EE96011)



✉ YAM Yeung

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1996-97 Haptic Device for Virtual Reality  
Application (EE96010)

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see also <P972716>, <P973427>, <P973428>, <P974709>

## RESEARCH PROJECTS

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### A Class of New Time-Varying Network Models with Controllable Flow Departure/Arrival Times

✉ CAI Xiaoqiang • WONG Chak Kuen (Computer Science & Engineering)

☐ 1 January 1998

❖ Research Grants Council

The researchers plan to study a new class of time-varying network models with controllable flow departure/arrival times, where a flow can stay at a node to wait for the best departure time, at a waiting cost, and can traverse an arc with a faster speed, at a speedup cost. Algorithms which can exploit the multi-period structures of a time-varying shortest path problem will be studied first, and various issues on how to reduce computational requirements will also be examined. To solve minimum cost flow problems, maximal flow problems, and other related models, they will investigate approaches which can successively apply shortest path computations to construct an optimal solution. Examination of issues such as how to re-design these approaches to accommodate time-varying network structures and parameters, and how to modify the time-varying network shortest path algorithms so that they can be used in generalized dynamic residual networks, will be a key part of the project. In addition to algorithmic studies, the researchers are also interested in basic issues such as complexity in terms of NP-completeness, optimality properties, and solvability of special cases.  
(CU97528)

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### New Models in Capacitated Lot Sizing Decisions

✉ CHENG Chun Hung

☐ 1 November 1997

❖ CUHK Research Committee Funding

Existing research in capacitated lot sizing problem (CLSP) often assumes setup time to be negligible. Although there have been efforts to reduce setup times, it is not possible to reduce them to near zero in many industries. Hence, excluding setup times from CLSP models is not practical, especially when setup times are significant and production capacity is tightly constrained.

In this research, the researcher plans to address this limitation. He will develop general models considering alternate production options. In particular he will investigate the inclusion of setup times. Further he will study the structure of the problem and develop solution algorithms based on the underlying structure. Extensive computational study will be carried out.  
(CS97009)

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### Self-tuning Neural Control Systems and their VLSI Implementation

✉ LAM Kai Pui • POON Chi Sang\*

☐ 1 October 1997

❖ Research Grants Council

Self-tuning adaptive control and neural networks are well established research disciplines in systems science and engineering. Recent years have seen the integrated use of major techniques developed in these two fields, for tackling practical control applications in non-linear, and largely unknown systems, perturbed by unpredictable disturbances. In contrast to most neural adaptive control systems, this proposal aims at developing new self-tuning neural control systems with a biomedical and physiological emphasis. The study has two major engineering objectives: the first is to understand the intricate adaptive nature of human neural control systems as evidenced in respiration and circulation; the second is to derive biologically inspired intelligent control techniques for general engineering applications. Research in this direction is challenging due to the complexity of many unknowns of the human neural system, and also to the excessive computing time for simulating and emulating clusters of biological neurons to a sufficient granularity. An important part of this study is to develop a more practical real-time computing platform by designing specific analogue VLSI chips, to be used with a field-programmable interconnect system for implementing the self-tuning neural control system. It is envisaged that the platform would provide the necessary flexibility for evaluating different chip designs, for validating the emergent behavior of artificial neural networks with specific hypotheses, and for realizing a practical real-time emulator for self-tuning neural control applications.  
(CU97525)

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### Knowledge-Based Chaotic Prediction for Financial Engineering Applications

✉ LAM Kai Pui

☐ 1 December 1997

❖ CUHK Research Committee Funding

Financial time series, such as stock prices, options and index, are often highly erratic and contain complex behaviors which make their accurate prediction, even on a short-term basis, extremely difficult. Recently, Barahona and Poon's work (1996) on deterministic chaos detection has generated much interest in short-term prediction of nonlinear time series. Empirical study under a wide range of problem context accumulates a substantial amount of ad-hoc knowledge for its effective use. The proposed

work is to extend the previous work of the principal investigator on a fuzzy expert system for technical analysis of stocks, by integrating knowledge based techniques with chaotic detection of financial time series. The field of using chaotic prediction in finance is still not fully developed, and there is much ground for further research and development on this novel integrated scheme. The effectiveness of the scheme would be evaluated with methodologies such as neural predictors and evolutionary computing. (CS97010)

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#### AICAMS Prototype Development

- ✉ LAM Kai Pui
- 1 March 1998
- ❖ The Hong Kong Police Force

AICAMS (Artificial Intelligence Crime Analysis and Management System) is an on-going collaborative project between The Hong Kong Police Force and The Chinese University of Hong Kong. The project aims at applying artificial intelligence, knowledge-based and map-based technologies for improving detection rates of reported crime and reducing the incidents of crime. Work on a pilot system has commenced in Tuen Mun in April 1997 and is proceeding to a functional prototype by February 1999. (EE97014)

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#### A Bayesian Framework for an Intelligent Information Filtering System under Dynamic Environments

- ✉ LAM Wai
- 1 March 1998
- ❖ CUHK Research Committee Funding

Due to the explosive growth of information such as the WWW and numerous electronic document collections, information filters are essential for users to sift out relevant items from incoming information. The objective of this project is to develop an intelligent information filtering system based on a Bayesian framework for dynamic environments. A number of issues are involved in developing a filtering system. The information, such as text-based documents, is raw and unstructured. The volume of information is extremely large. The researcher proposes an intelligent information filtering system, based on a Bayesian framework, offering the following features: (1) intelligent user feedback handling; (2) supporting dynamic nature of users; (3) supporting dynamic nature of documents; (4) content-based filtering. Specifically, he employs *Bayesian inference networks* which were a relatively new technique for representing and reasoning knowledge under uncertainty. The filtering process is treated as a

decision making problem which attempts to determine, under uncertainty, the degree of relevance of an incoming document to a user. This decision process will constantly improve as the filtering system interacts with the user. The system achieves this capability by capturing the user's interests automatically via a machine learning approach. It can also handle dynamic environments including changing user's interest and different information content. There are a variety of potential applications in business, information science, journalism, etc. (CS97011)

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#### Global Logistics Management: Combinatorial Optimisation Methods for Supply / Distribution Network Planning

- ✉ LEUNG May Yee Janny
- 1 December 1997
- ❖ Research Grants Council

For multinational firms with production facilities and customers scattered around the world, managing their global production / distribution networks is a complex task, but many of these companies have recognized the strategic competitive advantage to be gained by the effective management of the logistics function.

This research project addresses the logistics problem faced by global operations, particularly those with operations in Hong Kong and the Asia-Pacific region. Managing a global supply and distribution network involves the simultaneous optimization of customers and distribution centres to manufacturing facilities, and setting production and shipment volumes, which results in a large-scale combinatorial optimization model. Problems of such complexity were considered beyond the state-of-the-art in optimisation methods, and managers have resorted to heuristics in the past.

However, recent research in solution methodology for combinatorial optimisation problems indicates that the polyhedral approach may be an effective one. The researcher plans to investigate the viability of this approach for solving large-scale combinatorial optimisation models for logistics network planning and management, and to incorporate it in a decision-support system. Working with companies with a base in Hong Kong, the researcher plans to test the usefulness of such a decision-support tool, particularly its applicability to logistics planning and management in the Asia-Pacific region. (SS97069)



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### Variance Minimization in Stochastic Systems

- ✉ LI Duan
- 1 December 1997
- ❖ Research Grants Council

In engineering design, the concern of uniform resource allocation often leads to a variance minimization problem. In portfolio selection, almost every investor would like to maximize his/her expected return while minimizing his/her risk that is represented by a variance term. In some stochastic systems, the uncertainty, that can be characterized by a variance term, can be significantly reduced through active learning or probing. On one hand, variance minimization problems are widely encountered in real-world applications. On the other hand, variance minimization is a notorious problem in optimization due to the associated properties of nonconvexity and nonseparability. There does not exist an efficient solution framework in the literature to deal with a general class of variance minimization problems. A novel approach using parametric iterative dynamic programming will be developed in this project to tackle variance minimization problems by exploring special features in variance minimization. Convexification and separation schemes will be adopted to overcome the computational difficulties in variance minimization and to seek an analytical optimal feedback control law by a mathematically tractable setting. This proposed research will advance the state-of-the-art in optimization. Applications in resource allocation, dynamic portfolio selection, and dual control will be pursued. (CU97523)

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### A Logic Based Intelligent Information Retrieval Framework

- ✉ WONG Kam Fai • CHENG Chun Hung • LAM Wai • HE Jia (Finance) • LOW Boon Toh • HO Kei Shiu Edward<sup>#</sup>
- 1 July 1997
- ❖ CUHK Strategic Research Program

The purpose of Information Retrieval (IR) is to find the set of relevant information objects (e.g. documents) in a collection about a user's information need. Conventional IR systems are based on exact matching. An IR system attempts to match a query against each document in the collection and the closely matched ones are extracted. However, this mechanism is imperfect as embedded information in a document is often vague and imprecise. Existing systems can only cope with surface semantics of documents, e.g. keywords. They lack the ability in handling the subtle deep semantics including uncertainty. To overcome this predicament, a new theoretical framework is sought. In coping with

document semantics, deep and surface alike, both statistic and probabilistic information will be used. This involves the definition of a formal inference model based on logic. Logic is a normalisation of the way we acquire knowledge, make decisions and so forth. It provides a sound basis for capturing the semantics, vagueness and imprecision of the information in a document collection. It can also be used to retrieve the relevant documents from a collection in an intelligent manner. (CS97001)

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### Legal Reasoning for Distributed Information Retrieval

- ✉ WONG Kam Fai
- 1 November 1997
- ❖ CUHK Research Committee Funding

Today widely distributed information retrieval environment is getting increasingly popular. A good example is the Word-Wide-Web (WWW). As the complexity and the distribution network of the WWW grows, handling of the underlying information is getting more and more difficult. To overcome this predicament, researchers have started to investigate logic based information retrieval models. The use of logic to IR can provide not only information extraction, but it also facilitates information reasoning, which is a key to effective retrieval. Argumentation is a popular logic based technique for non-monotonic reasoning and is suitable for handling distributed information. However, existing argumentation frameworks can only cope with exact information. At present, the information distribution network is widened rapidly. The volume of inexact information increases alongside it. This will render existing argumentation framework ineffective. The primary objective of this project is to design a new argumentation model which can cope with argument conflicts - a consequence of inexact information. This model is based on legal reasoning formalism. As such, when a conflict is encountered, the model will attempt to resolve it; however, if the current data in the knowledge-base is insufficient, it will tolerate the conflicts until enough knowledge is collected. (CS97012)

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### Computerized Qualitative Research Analysis

- ✉ WONG Kam Fai • SO York Kee Clement (Journalism & Communication) • SO Lai Man Stella (Marketing)
- 1 February 1998
- ❖ CUHK Research Committee Funding

The objective of this project is to develop a software system to automatically code and analyze data

collected from qualitative researches, such as from open ended questions, interviews, etc.; particular interests are paid on research data expressed in Chinese natural language. The deliverable of the project will be beneficial to both industrial practitioners and academics, especially in the area of marketing consulting, social science research and marketing research for China, Hong Kong and Taiwan.  
(EE97013)

### Manufacturing Logistics with Application to Electronic Equipment Assembly and Distribution

- ✉ YAN Houmin
- 1 September 1997
- ❖ CUHK Research Committee Funding

Manufacturing logistics process re-engineering is the search for and implementation of radical change in manufacturing logistics processes to achieve breakthrough results. In this project, the researcher plans to analyze and develop a supply chain model for the assembly and distribution of electronic equipment and devices. He intends to generate a better supply chain model by re-engineering manufacturing logistics processes. This project is motivated, in part, by then recent visits to several local manufacturers of electronic equipment and devices, such as Kong Wah Electronic Holding Ltd., and C & K Security Systems. There are several features that distinct out problems from the traditional model. There is an unprecedented number and varieties of products. Product life cycles are very short. Forecasts of volatile demands are quite inaccurate. Furthermore, the manufacturing efficiency strongly depends on suppliers for key components. How to reduce the lead-time, and finished-product inventory without downgrading the customer service is an important topic. The researcher addresses three issues in this project. First, he will build a supply chain model which captures basic blocks of the supply chain including raw material and components supply, electronic card assembly, product assembly, and finished product distribution. The model serves as a tool to validate and/or compare strategies and alternatives. Second, he will analyze the impact of process re-engineering, especially re-engineering manufacturing processes, on lead-time and costs. The quantitative assessment serves as a guide line to predict the necessity of process re-engineering. Third, he will develop a procedure to assign key parameters for the supply chain in an optimal or near optimal fashion. The researcher expects that the research will contribute numerous new and interesting results to the manufacturing logistics and supply chain fields. From a practical point of view, he expects that the research will lead to effective methods that provide strategic and operational benefits to regional industries.

(EE97012)

### New Challenges in Optimization of Stochastic Diffusion Processes

- ✉ ZHOU Xunyu
- 1 October 1997
- ❖ Research Grants Council

Dynamic Optimization of stochastic diffusion processes occurs in many real-world systems including physical, biological, economic and management systems. Its theory is believed to have been well-established based on Pontryagin's maximum principle and Bellman's dynamic programming. However, this belief is challenged by the recent finding that a class of stochastic linear quadratic regulator (LQR) problems with negative control weight costs is sensible and well-posed. This phenomenon, together with the fact that neither the existing stochastic maximum principle nor the dynamic programming approach is able to fully characterize optimality for this class of problems, is quite contrary to the deterministic case and reveals some deep nature of the stochastic diffusion systems. This project aims to solve the above non-conventional stochastic LQR problems by studying a stochastic Riccati equation, to develop new stochastic maximum principle by introducing nonlinear adjoint equations, and to suggest some numerical schemes by investigating verification theorems.  
(CU97518)

### Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1995-96	Manpower Planning and Scheduling with Staff of Mixed Skills (CU94543) ✉ CAI Xiaoqiang • LUM Vincent Yu-Sun • ZHOU Xunyu • YAN Houmin
1996-97	New Scheduling Models with Applications to Berth Allocation (CU96543) ✉ CAI Xiaoqiang • LEE Chung Yee
1995-96	Implementation and Application of Binary Relation Inference Networks (CU93510) ✉ LAM Kai Pui
1995-96	Real-time Systems Diagnosis with Microprocessor Applications (CU95517) ✉ LAM Kai Pui

1996-97	Intelligent Investigation Support System - An Application to Computer-Aided Crime Investigation (CS96017) ✍ LAM Kai Pui • BRAHAN J. W.*	✍ WONG Kam Fai
1996-97	Neural-Network Based Multiple Models for Adaptive Control Applications (CS96002) ✍ LAM Kai Pui • CLARKE D. W.*	1995-96 Towards a Natural Language-oriented Chinese Information Retrieval System (CU94519) ✍ WONG Kam Fai
1996-97	Knowledge Engineering Laboratory - Applying Artificial Intelligence Research to Industrial Applications (CS96014) ✍ LAM Kai Pui • LOW Boon Toh • LAM Wai	1996-97 Linguistic Knowledge Acquisition for a Chinese Noun Phrase Parser (CS96013) ✍ WONG Kam Fai
1996-97	Distributed Learning of Bayesian Inference Networks (CS96011) ✍ LAM Wai	1996-97 A Machine Tractable Chinese Thesaurus and its Application to Natural Language Processing (CS96019) ✍ WONG Kam Fai • LUM Vincent Yu-Sun
1996-97	Saddle Point Generation in Nonconvex Optimization (CU96545) ✍ LI Duan	1996-97 Robust Production Scheduling in High Tech Manufacturing (CU96532) ✍ YAN Houmin • SETHI Suresh P.*
1996-97	An Empirical Analysis of Stochastic Volatility Model (CS96012) ✍ LIU Ming	1995-96 Dynamic Near-Optimization and Applications (CU94502) ✍ ZHOU Xunyu
1994-95	Retrieval-By-Sense — a Novice Scheme for Information Retrieval (CS95001) ✍ WONG Kam Fai • LUM Vincent Yu-Sun • PAN Haihua <sup>#</sup>	1995-96 Asymptotic Optimality of Hierarchical Production Policies in Discrete Event Manufacturing Systems (CU95520) ✍ ZHOU Xunyu
1995-96	A Chinese Database Management System Interface (CU94517)	1995-96 Maximum Principle for Singular Controls in Finance (CS95012) ✍ ZHOU Xunyu

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## RESEARCH PROJECTS

### Universal Hong Kong Cantonese Characters Set Font Development Project

✍ CHEUNG Kwok Wai • HUANG Erwin\* • TSE Aaron\* • TSE Ping Kin Ken\*

☐ 1 September 1997

❖ Industrial Support Fund, Industry & Technology Development Council

The Cantonese Character set project is designed to create an "Industry standard" Cantonese character set table for publishers in Hong Kong. It is designed to make digital transfer of information between different publishers, companies and Internet based readers possible and much easier.

Deliverables include two sets of Freely Licensable Chinese fonts with Hong Kong characters embedded, basing on both the Taiwanese (big-5 standard) and PRC (GBK standard), that Content Providers in both the Private and Public sector can distribute freely for use in their in-house publishing systems and to their readers. Also, a set of electronic filters will also be developed for all major publishing platforms on the market, so that the Publishing Industry can transfer files from their Desktop Publishing to this Standard character set format easily and automatically. Therefore, the target users of the project include all Content providers in the publishing industry, as well as all the Internet users who read Hong Kong-based Chinese publication on the Internet. The Cantonese character set shall be submitted to the ISO 10646 committee for standardization after its adoption by the local industry.

With the development of such a project, the local Publishing Industry members, in the private or public sector, will have removed a major obstacle that is hindering them from moving into the new Digital Publishing world of the Internet and CD-ROMs. Since Digital Publishing is the accepted future of the large Publishing Industry, and Internet based information systems will become the basis for future Businesses, this project will enhance Hong Kong's ability to compete in this important area.

(CS97002)

### Electronic News Media & Publishing Consortium - Second Phase

✍ CHEUNG Kwok Wai • LAM Wing Kwan • LAU Chun Hung • YEUNG Yim Shan

☐ 1 October 1997

❖ Industrial Support Fund, Industry & Technology Development Council

Electronic News Media and Publishing Consortium (ENMPC) has been enjoying tremendous success in its first phase implementation (October 1995 to

September 1997) in both the member subscription and facility usage. This project, ENMPC Second Phase, serves to extend the dedicated Internet services to members to help them achieve self-sustainable operation in applying IT in their businesses. On top of this, the researchers will provide the following specific solutions to the industry:

- (1) Tailor-made solutions to ENMPC members including Cyber bookstore, Cyber News Library and Cyber News Agency Services Centre
- (2) Provision of Network Infrastructure and Platform
- (3) Consultation
- (4) Promotion on local electronic publishing

Eventually, the news media and publishing industry shall be benefited from being empowered to incorporate Internet and other IT tools to streamline their business process and explore new business opportunities.

(CS97013)

### Integrated Communications Laboratory

✍ CHEUNG Kwok Wai • LEE Kin Hong (Computer Science & Engineering) • LEUNG Hong Chung (Electronic Engineering) • HO Keang Po Ricky (Information Engineering) • CHING Pak Chung (Electronic Engineering) • CHAM Wai Kuen (Electronic Engineering) • WEI Keh Wei Victor (Information Engineering) • FONG Chi Bun • KO Kin Wa • CHAN Kwong Wing

☐ 1 June 1998

❖ Industrial Support Fund, Industry & Technology Development Council

With the emergence of the internet as a new distribution media, tremendous new product opportunities arise from the convergence of telecommunication, computer and consumer products. However, local manufacturers in telecommunication products or consumer electronics products are not familiar with the converging technologies outside their main field of expertise. The set up of the integrated communications laboratory (ICL) is to strengthen the research, design and development (RD&D) capability of our local electronic industry in the area of advanced integrated communications products (both hardware and software). The laboratory will serve as a strong link between the local electronic industry and the academia and train up postgraduate students with expertise in engineering design and development that can immediately benefit the local electronic industry through direct physical transfer to the industrial sector or through technology licensing of the completed research prototypes.

(EE97020)



**Please refer to previous issues of this publication for more details of the following ongoing research at the department:**

Edition      Title/Investigators

1995-96      Electronic News Media and Publishing Consortium (CS95011)  
✉ CHEUNG Kwok Wai • CHI Chi Hung (Computer Science & Engineering)<sup>#</sup>