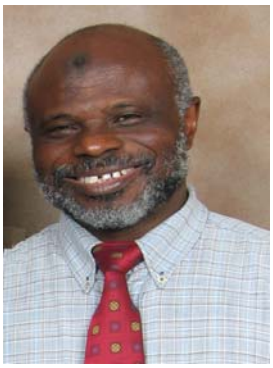

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Modern Perspective of Signal Modeling Techniques: Theory, Application and Future Directions

Summary

Signal modeling has evolved to be an important aspect of digital signal processing which has been successfully used to solve variety of problems in communication, control, biomedicine, geophysics, atmospheric science, and this list could continue. Signal models, which could be either parametric (with an assumption of certain functional form) or nonparametric techniques, entail efficient mathematical representation of data or signal so as to extract desirable information from either the signal or the system that generates it. Since the early work of Yule (which led to the development of Yule-Walker equations), several signal models have been developed and successfully used in various problems which include spectral analysis, speech processing, system identification, signal filtering and prediction. Though several signal models are available, both the AR and ARMA models are widely used in many application areas as they possess some desirable properties. Consequently, a lot of research efforts have been concentrated on these two models since the last three decades.

This presentation discusses the theoretical framework of signal models, especially with respect to the AR and ARMA models. The performance of these techniques would be examined and some areas of applications would be highlighted. The infusion of the intelligent techniques to signal modeling, especially to aid in the computation of the model parameters would be reviewed. The author's experience in the use of AR/ARMA models for the design and development of pressure-based typing biometric authentication system, propane-fuelled valveless pulsed combustor data analysis, transient multiexponential signal analysis, MRI reconstruction, mould analysis and reconstruction, teeth identification (via shape analysis), and crack analysis and prediction would be illustrated. Finally, future directions of this important area of research would also be discussed.

Biography

Momoh Jimoh E. Salami received the B.S.E.E degree from the University of Ife, Ile-Ife, Nigeria in June 1977, and a Ph.D degree in Electrical Engineering from the University of Calgary, Calgary, Canada in 1985. He has been actively involved in the teaching and research activities at the university level in Nigeria, Saudi Arabia and Malaysia since the completion of his graduate studies. He joined International Islamic University Malaysia (IIUM) in September 1996 and he is currently a Professor in the Department of Mechatronics Engineering as well as the Deputy Dean of Postgraduate and Research, Faculty of Engineering, IIUM. He has authored/co-authored more than 100 publications in both local and international journals and conference proceedings as well as being one of the contributors in a recently published book entitled 'The Mechatronics Handbook' edited by Prof. Bishop. His research interests include digital signal and image processing, intelligent control system design and instrumentation. Prof. Momoh is a senior member of IEEE.

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Humanoids and Multi-robot Systems

Summary

In this paper, we present the work carried out at the Centre for Artificial Intelligence and Robotics (CAIRO), Universiti Teknologi Malaysia, in the area of humanoids, multi-robot cooperation and human-robot interaction.

The first part reports on the humanoid robots being developed focussing on stable walking gaits, interaction with environment in terms of balancing capability with side and frontal rolling of the ground platform.

The second part of the presentation concentrates on work in developing multi-agent robotic systems. A multi-robot system with behaviour-based features has been successfully designed and built. The multi-robot system can be in a two-robot arrangement to carry large beam-type objects or as a three-robot formation for very large objects. It is able to detect obstacles and perform obstacle avoidance, detect walls and perform wall following, search for passageways and move out of constricted spaces. It uses a novel technique of hybrid-decentralized reactive behaviour-based control architecture, and establishes a intra-robot communication capability using RF and Zigbee. The system has proven to be very successful in coping with unknown and unstructured spaces such as rooms and spaces with doors.

The next part of the presentation is on human-robot interaction, in serving, helping or even entertaining humans as partner robots. The partner robot will try to get he human attention and attempts to attract the human to interact with it. This paper also explores methods for the human to interact effectively and safely with a mobile robot in office or home environment.

Biography

Dr. Shamsudin H.M. Amin is a Professor of Mechatronics and Robotics Engineering in Universiti Teknologi Malaysia (UTM). He is attached to the Centre of Artificial Intelligence and Robotics (CAIRO) as well as at the Department of Mechatronics and Robotics Engineering, Faculty of Electrical Engineering, UTM. He has served in UTM since 1980 in various positions. Currently he is the Director of UTM's Research University Secretariat.

He obtained his Bachelor of Engineering in Control Systems in 1980 from the University of Sheffield, United Kingdom. He later obtained his MSc. and Ph.D from the same University.

He has served as an active member of IEEE Malaysia, and was chairman for the year 2001-2002. He is a member of the Asian Control Professors Association since 1996. He is the Convenor for the Robotics Round Table, a forum for 45 researchers in robotics field in Malaysia (looking into medical robotics, agriculture robots, robots in manufacturing industry, humanoids, robots in construction industry, vision based robotics). He has also served as a member of International Program Committee in numerous international conferences, including as Advisor to the inaugural SCOReD in 2001.

He is the Chief Editor of *Jurnal Teknologi D: Electronics, Control, Telecommunications and Information Technology*, national journal published by UTM Press since 1998. He is also an associate editor for Polytechnica, a journal published in Budapest Hungary. In 2004 he received UTM's excellent service award, and in 2007 received award for journal article publication.

His research interests: Intelligent mobile robots, biologically inspired robots, vision system for automated inspection, wall climbing robots, multi-agent robotic systems, behaviour-based robotics and humanoids. He has led UTM Robocon team to represent Malaysia in 2003, 2004, 2005.

From 2001-2005, he served as a member of the Prioritised Research Technical Committee for IRPA, a national research funding body at Malaysian Ministry of Science, Technology and Innovation. He is a steering committee member of the International Conference on Mechatronics Technology and founding member of the Asian Mechatronics Association. He has registered 4 patent pendings.

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Human Centered Robotics – Future Challenges

Summary

The futuristic vision of intelligent devices that interact with and help humans in their everyday life is beginning to be a reality, particularly due to the recent advances in computing, sensing, control, machine learning and miniaturisation. The ability to build intelligent devices that can coexist and cooperate with humans as well as manipulate the human environment opens up an enormous number of applications ranging from exoskeletons for the disabled or strength augmentation, active artificial limbs that sense user actions and adapt to the environment, to active devices in the home that can ubiquitously help in everyday living. More generally, "pervasive robotics" is widely seen as the next step in the evolution of "pervasive computing", where computing devices are endowed with the ability to act on the environment. Recent research in robotics has demonstrated the significant challenges that need to be overcome in order to make a machine effectively cooperate with a human, in contrast to building an autonomous machine that operates on its own or in collaboration with other machines. This talk will present the current status of the research on human centred robotics and will focus on the key future challenges in this area.

Biography

Gamini Dissanayake is the James N Kirby Professor of Mechanical and Mechatronic Engineering at University of Technology, Sydney (UTS). His current research interests are in the areas of localization and map building for mobile robots, navigation systems, dynamics and control of mechanical systems, cargo handling, optimisation and path planning. He leads a team of thirty robotics researchers at the UTS node of the Australian Research Council Centre of Excellence for Autonomous Systems. He graduated in Mechanical/Production Engineering from the University of Peradeniya, Sri Lanka in 1977. He received his M.Sc. in Machine Tool Technology and Ph.D. in Mechanical Engineering (Robotics) from the University of Birmingham, England in 1981 and 1985 respectively.

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Mixed Multi Agent Collaboration

Summary

Researchers have dedicated much effort to the development of autonomous robotic system. The aim is to operate without any human assistance or intervention. In an unstructured and dynamic environment this is not readily achievable due to the high degree of complexity of perception. For many real-world applications, it would be desirable to have a human in the control loop for monitoring, detection of abnormalities, and to intervene as necessary. In many complex tasks, as typified by defence and hazardous applications, full autonomy may be undesirable. Such complex tasks require human attributes of judgment, reasoning and control to ensure desirable operations and outcome. Robots are generally not perceived to possess these human attributes.

It is, however, possible for current-state-of robots to perform useful tasks and to provide appropriate assistance to the human, to correct his control input errors by supporting perception and cooperative task execution. Systems which facilitate cooperation between robots and human are becoming a reality and are attracting increasing attention from researchers. In the context of human-robot cooperation, one concern is the design and development of flexible system architecture for incorporating their strengths based on their complementary capabilities and limitations.

Biography

Gerald is currently an Associate Professor with the School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore. He lectures in mechatronics, engineering design and real-time systems, at undergraduate and graduate level. He holds a concurrent appointment as Director of the Robotics Research Centre, and as Head of the Division of Mechatronics and Design.

His main research interests are in mechatronics and field robotics, with specific interest in underwater mobile robotics and fluid power systems. He has authored, and co-authored over 80 peer refereed papers. He is a consultant to industry in these areas. Recently, his research interest has extended to include Unmanned Aerial Vehicles (UAV) and collaborative robotic systems.

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Application of FEM in Mechanical Design

Summary

Finite element method (FEM) is a numerical procedure originated for stress analysis. Its applications are extended to heat transfer, fluid flow, electromagnetic fields, bio-engineering and many other fields of engineering. Today a number of commercial softwares are available on personal computers.

The practicing engineers should understand how various elements behave to enable them to use to a better advantage and will be less likely to misuse them. Such an understanding is not possible ignoring the theory behind the method and formulation procedures for various types elements, and concepts behind the codes should be mastered. Otherwise the results may be misleading and designs may lead to failures. The utility of finite element methods in the design of complex problems are explained with the following example problems.

1. Finite Element Analysis of Printed Circuit Board(PCB) Assembly

Die and printed circuit board (PCB) also known as substrate assemblies are widely used in electronic equipments such as mother boards, mobiles, pagers and other small electronic components. A closed form solution to thermal stress and warpage of a die-substrate assembly was developed by Suhir. In closed form model, bump volume is distributed over the area. This is not realistic. Hence a finite element model is created for analysis, and the results are compared with analytical model. In the present study Tsai solution is used for estimating thermal stresses in the die attach and warpage of chip scale package (CSP). Park solutions is used for estimating the warpage of the overhang length of the PCB of chip on board (COB). Sn63-Pb37 solder is used as a die attach in the form of bumps are distributed between the die and substrate. The finite element method gives better approximation of deformation and stresses.

2. Evaluation of effective material properties of heterogeneous materials through homogenization

A homogenization methodology is proposed to determine the material properties of heterogeneous materials using finite element analysis through representative volume elements

(RVE). The constituents of this RVE are described by elasto plastic material properties. The RVE are subjected to six load cases and the volume averaged responses are analyzed simultaneously to predict the anisotropic properties. The mechanical behaviour is simplified to orthotropic material model with Hill plasticity and the properties are verified with micromechanical simulation and experimental results available in the literature. Formulae for elastic properties are also derived by a simplified analytical method based on lamination theory and compared with those obtained from homogenization.

3. **Failure Analysis of Flat-Joggle-Flat Joints in Composite Laminates**

Composite laminate are extensively used in aerospace applications. Adhesive joints are used to improve the efficiency of the joints. A 3D finite element analysis is performed to study the propagation of damage and to predict failure load in Flat-Joggle-Flat (FJF) joints using equivalent material properties. FJF joints are developed to overcome the effect of bending when in-plane load is applied. The design of FJF joints helps to eliminate eccentricity by the presence of joggle so that loading is in-plane and avoids bending effect thereby increasing the strength of the joint. Laminates are prepared using glass fibre/epoxy with $[0^o/45^o/\text{-}45^o/]_s$ and $[0^o/90^o/0^o]_s$ lay up. Failure in FJF joints by equivalent material properties predicted the strength of the joint close to the experimental values.

Biography

N.Siva Prasad obtained B.E. (Mech) degree from the University of Mysore in 1975, M.Tech. and Ph.D degrees from IIT Madras in the year 1977 and 1984 respectively. He has been working in IIT Madras since 1977 in various capacities, and as a professor of Mechanical Engineering for the past 14 years. His areas of research are Machine Design, Finite Analysis, and Computer Aided Engineering. He has guided over 20 Doctorate and Master of Science research theses works apart from a large number of post-graduate and under-graduate project works. He has published over 80 papers in various journals and refereed conferences.

He has organized a number of conferences, continuing education programs for the Industry in India. He has completed a good number of mechanical design consultancy projects helping the Indian industry and R&D establishments

He visited UK with British Council scholarship, Germany with DAAD fellowship, US, China, Malaysia on different occasions. He is a member in a number of National Bodies and professional societies in India.

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Biologically Inspired Computations to Solve NP Problems

Summary

The goal of combinatorial optimisation problems is to search for the best possible solution with the lowest costs. In some cases, this task is almost impossible. To overcome these challenges, researchers have shifted their attention from to new computational paradigms, such as DNA computing.

This talk aims to expand and investigate a new set of applications for DNA computing. Especially, NP hard and complete problems will be discussed. All the combinatorial are computed using DNA at onetime. This particular characteristic of DNA computation changes the DNA hard and complete problem into linear polynomial time computation.

Biography

Dr. Junzo Watada received his B.S. and M.S. degrees in electrical engineering from Osaka City University, Japan, and Dr. of Eng. degree through the research on fuzzy multivariate analysis from Osaka Prefecture University, Japan.

He is a Professor of Knowledge Engineering, Soft Computing and Management Engineering at the Graduate School of Information, Production & Systems, the Waseda University since 2003, after a professor of Human Informatics and Knowledge Engineering, at the School of Industrial Engineering, the Osaka Institute of Technology, Japan. Also Dr. Watada gave a lecture on Management Information Systems for 8 years at Faculty of Business Administration, Ryukoku University at Kyoto. Before moving to Academia, he was with Fujitsu Co. Ltd. as a senior systems engineer for 7 years.

His research interests includes macro-ergonomics, human interface, human tracking system, decision making, and management of technology and engineering as well as fuzzy

system methodologies, automata theory, text and web mining, decision support systems, experts systems, DNA computing, data analysis, etc.. Recently he works actively on real options based evaluation and decision making as well as financial engineering. He published more than 400 academic papers including about 150 journal papers.

He was the President of Bio-Medical Fuzzy Systems Association (2001-2003) and the Vice President of Japan Society for Fuzzy Theory and Systems for two years (1993-1995). Dr. Watada was a board member of Japan Society for Fuzzy Theory and Systems, and also served as an advisory board member for several international and domestic societies and also an editorial board member for international and domestic journals including the principal editor of BSCHS and ICIC express letters.

Dr. Watada is a recipient of several awards. Some of them are with his students.

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Role of FEM in the Analysis and Optimum Design of heat Exchangers

Summary

Finite element modeling procedures for heat exchangers are discussed. FEM is also used to study the performance of heat exchangers as a function of several variables. Then FEM modeling approach to solve the momentum and energy equations to obtain the heat transfer coefficients and skin friction coefficients follows. Flow over tube bundles in laminar flow and flow in a duct with disk and doughnut in turbulent flow are studied to obtain the fluid flow and heat transfer characteristics.

The application of tools like ANN and GA are illustrated in consolidating the parametric studies and optimization of a micro-compact heat exchanger respectively.

Biography

Prof K.N Seetharamu is born on 22nd August 1939. He graduated from Mysore University in Mechanical Engineering in the year 1960. He obtained his Masters Degree in Power Engineering in the year 1962, from Indian Institute of Science, Bangalore. He obtained his doctoral degree in 1973, in the field of heat transfer from Indian Institute of Technology, Madras. His doctoral thesis was judged as one of the excellent thesis by Prof. Rohsenow from MIT, a world-renowned person in the field of heat transfer.

He has an industrial experience of more than 3 years (Oct. 1962 - Dec. 1965) in a paper mill before he joined the academic life. He served BIT Ranchi as an Assistant Professor from 1965-1968. He joined Indian Institute of Technology, Madras in the year 1968, as a lecturer and rose to the level of Professor in the year 1980. He joined the School of Mechanical Engineering, University Science Malaysia as a Professor in the year 1996 **on invitation**. He took voluntary retirement from IIT Madras in September 1998 to continue his assignment at University of Science Malaysia. He has got more than 40 years of professional experience.

His areas of interest are heat transfer, fluid flow, stress analysis, energy systems, electronic packaging, and FEM applications to engineering problems. He is also working on the application of ANN and GA for optimization problems. He has contributed extensively in the areas of Porous Medium, Heat Exchangers, Thermal Management in Electronic Systems etc. Currently he is active in the application of FEM to Financial Problems.

Prof. Seetharamu has supervised 30 students for Ph.D Degree and 32 students for Masters Degree by research. 18 students have completed their Masters Degree by research in the area of electronic packaging.

He has published more than 160 papers in International Journals,12 papers in National Journals, 95 papers in International Conferences and another 105 papers in National Conferences. He has published a book on *"FEM Applications to Heat Transfer"*, published by John Wiley in 1996 along with co-authors from UK. Recently he has published a book: *"Fundamentals of FEM in Heat and Fluid Flow"* through John Wiley in April 2004. He has published a book "Engineering Fluid Mechanics" with Prof. P A Aswatha Narayana in June 2004. He has carried out many national and international collaborative projects. He has also contributed a chapter on thermal management in the book *"Fundamentals of Microsystems Packaging"* edited by Rao Tummala and published by McGraw-Hill in 2001. He has also contributed chapters in *"Modeling in Welding, Hot Powder Forming, and Casting"* book edited by Lennart Karlsson, published by American Society of Metals in 1997. He has also contributed a chapter in the book *"Handbook of Residual Stress and Deformation of Steel"* published by ASM in 2002.

Prof. Seetharamu established IMAPS Malaysia Chapter in the year 1998 and IEEE-CPMT Malaysia Chapter in the year 2000 and continues to be active in this area. Prof Seetharamu is also active in offering continuing education programs to multi-national companies like Agilent, Intel, AMD etc. on the applications of Finite Element Method to electronic packaging as well as Thermal Management in Electronic Systems.. **He has joined PES Institute of Technology, 100ft ring Road, BSK III stage, Bangalore -560085 as a Chair Professor in Thermal Engineering in August 2007.**

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Nonlinear Feedback in the Human Cochlea: Modeling Its Role in Hearing

Summary

The mammalian ear is a remarkable sensory organ. It is capable of fine selectivity over a broad frequency range and of discriminating level differences of 1 dB over a dynamic range of 120 dB. This capability is provided by a number of nonlinear mechanisms within the ear; principal amongst which is that in the active feedback loops within the inner ear that amplify its mechanical vibration. This lecture will discuss the sources of this nonlinearity, how it might be modeled, and some of its consequences.

Of particular interest is the various types of otoacoustic emission that are generated by the ear as a result of this nonlinearity, and how these emissions may be used to help us understand the role of this nonlinear feedback in hearing.

Biography

Steve Elliott graduated with first class joint honours BSc in physics and electronics from the University of London, in 1976, and received the PhD degree from the University of Surrey in 1979 for a dissertation on musical acoustics.

After a short period as a Research Fellow at the ISVR and as a temporary Lecturer at the University of Surrey, he was appointed Lecturer at the Institute of Sound and Vibration Research (ISVR), University of Southampton, in 1982. He was made Senior Lecturer in 1988, Professor in 1994, and became Director of the ISVR in 2005. His research interests have been mainly concerned with the connections between the physical world, signal processing and control, mainly in relation the active control of sound using adaptive filters and the active feedback control of vibration. This work has

resulted in the practical demonstration of active control in propeller aircraft, cars and helicopters. His current research interests include modular systems for active feedback control and modelling the active processes within the cochlear.

Professor Elliott has published over 200 papers in refereed journals and 400 conference papers and is co-author of *Active Control of Sound* (with P A Nelson 1992), *Active Control of Vibration* (with C R Fuller and P A Nelson 1996) and author of *Signal Processing for Active Control* (2001). He is a Fellow of the Acoustical Society of America, the IET and the IOA and a senior member of the IEEE. He was jointly awarded the Tyndall Medal from the Institute of Acoustics in 1992 and the Kenneth Harris James Prize from the Institution of Mechanical Engineers in 2000.

Most Recent Journal Papers

171. C. PAULITSCH, P. GARDONIO and S.J. ELLIOTT 2006 *Journal of the Acoustical Society of America* **119**(4), 2131-2140.. Active vibration control using an inertial actuator with internal damping.

172. W.P. ENGELS, O.N. BAUMANN and S.J. ELLIOTT 2006 *Journal of the Acoustical Society of America* **119**(3), 1-9. Centralized and decentralized control of structural vibration and sound radiation.

173. L.E. REES and S.J. ELLIOTT 2006 *IEEE Trans. on Audio, Speech and Language Processing*, **14**(2), 711-719. Adaptive algorithms for active sound-profiling.

174. S.J. ELLIOTT 2006 In. *Control of Fluid Flow*, Petros Koumoutsakos and Igor Mezic (Eds). 123-136. Control of Acoustics.

175. M. MOSHREFI-TORBATI, A.J. KEANE, S.J. ELLIOTT, M.J. BRENNAN and E. ROGERS 2006 *International Journal of Solids and Structures* **43**, 6472-6487. The integration of advanced active and passive structural noise control methods.

176. E. RUSTIGHI and S.J. ELLIOTT 2007 *Journal of Sound and Vibration* **300**, 490-501. Stochastic road excitation and control feasibility in a 2D linear tyre model.

177. O.N. BAUMANN and .S.J. ELLIOTT 2007 *J. Acoust. Soc. Am.* **121**(1), 188-196. The stability of decentralized multichannel velocity feedback controllers using inertial actuators.

178. C. HONG and S.J. ELLIOTT 2007 *J. Acoust.Soc. Am.* **121**, 222-233. Local feedback control of liht honeycomb panels.

179. P.J.P. GONCALVES, M.J. BRENNAN and S.J. ELLIOTT 2007 *Journal of Sound and Vibration* **301**, 1035-1039. Numerical evaluation of high-order modes of vibration in uniform Euler-Bernoulli beams.

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