Preface

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Biographical notes: Pushkin Kachroo received his PhD in Mechanical Engineering from the University of California at Berkeley in 1993, his MS in Mechanical Engineering from Rice University in 1990, and his BTech in Civil Engineering from I.I.T Bombay in 1998. He received his PE licence from the State of Ohio in Electrical Engineering 1995. He received his MS in Mathematics in 2004 and PhD in Mathematics in 2007, both from Virginia Tech. He is currently an Associate Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Tech and a visiting Associate Professor at the University of Nevada, Las Vegas. He was a research engineer in the Robotics R&D Laboratory of Lincoln Electric Co. from 1992 to 1994, after which he was a research scientist at the Center for Transportation Research at Virginia Tech for about three years. He has four published books, three edited volumes and overall more than 80 publications including journal papers. He has been the Chairman of ITS and Mobile Robotics sessions of SPIE conference several times. He received the award of 'The Most Outstanding New Professor' from the College of Engineering at Virginia Tech. in 2001, and Dean's Teaching Award in 2005.

Kaan Ozbay received his BS in Civil Engineering in 1988 from Bogazici University, Istanbul, Turkey, and his MS and PhD in Civil Engineering (Transportation) in 1991 and 1996, respectively, from Virginia Tech, Blacksburg, Virginia, USA. His research interests in transportation cover real-time control for traffic management, application of operations research techniques for network optimisation, incident management, transportation economics, congestion pricing, and in general Intelligent Transportation Systems. He is a Professor of Civil and Environmental engineering at Rutgers University, NJ, USA. He is also the Director of the Rutgers Intelligent Transportation Systems (RITS) Laboratory (www.rits.rutgers.edu), which leads ITS research and education activities of Rutgers Center for Advanced Infrastructure and Transportation (CAIT), a Tier 1 University Transportation Center funded by USDOT. He is the recipient of the prestigious National Science Foundation (NSF) CAREER award. He has co-authored three books, and published more than 150 refereed papers in scholarly journals and conference proceedings.

Classical feedback control theory has been used for the design of operational amplifiers that use feedback, motor control, and process control. With the advent of inexpensive microelectronic technology that includes sensors, microprocessors, networking hardware, and actuators, many different types of problem have entered the framework of feedback control. As an example, transportation engineering has been going through a revolution and has created a new field called Intelligent Transportation Systems (ITS) that involves using traffic sensors on the road, processing the information, and then giving information to the drivers for smooth traffic flow operations. Transportation engineers have traditionally used operational research methods of optimisation for system design. Most of these methods have used static models of traffic. In order to extend the results from static optimisation to dynamic ones, methods like rollizon horizon optimisation have been used. The technique here is to solve the optimisation problem for a finite time and then apply only a portion of the control till the next sampling time, after which a new optimisation problem is solved. The problem with this approach is that no optimisation results are obtained for the actual implementation, which is a piecemeal glueing of the solutions of the different rolling time horizon problems solved. Moreover, computation has to be performed to solve the optimisation in real time, which, in general, is expensive. In addition, one does not obtain stability guarantees of the ‘closed loop’ dynamic system. This application is ideally suited for the use of feedback control theory, which is geared towards obtaining a control law that is designed to provide closed loop stability by using only a small amount of computations in real time.

There are many other application areas that have not been studied or explored extensively for the use of feedback control design methodology, even when the implementation follows a closed loop structure. One example is how the federal government changes the interest rate based on the economic health indicators for the nation. The interest rate is the control variable that has a direct impact on the economy, and by making it a function of the economic indicators, this implementation becomes a closed loop control. Hence, this area is definitely amenable to feedback control design methodology. However, we do note that to get aggregate dynamic models of the economy with mathematical relationships between various states and economic indicators and the control variable is non-trivial.

This special issue of IJCAT is presented to encourage researchers to use feedback control design methods for non-traditional feedback control problems when the implementation structure for closed loops is present in the system. The collection of papers presents different applications of feedback control, showing the reader how to use the framework in non-traditional areas. One such example is the feedback control theory used for pedagogy where abstract structures are used for knowledge representation in order for the feedback design to be realisable.