technology might have been detrimental as the inner workings of the derivations have been replaced by a fast overview at the detriment of a deeper understanding and appreciation of the beauty of the material.

Q. I see that you are involved in IEEE Control Systems Society (CSS) activities. Do you find these volunteer activities to be rewarding?

Marika: I have been involved as editor of some of the major publications in my area and in the organization of technical meetings and special sessions at conferences. I consider these activities an integral part of the profession. I believe they are important and rewarding if attention is paid to the welfare of the research community. Paying attention to the quality of the peer-review process is a must for anyone who is interested in helping to strengthen the quality of the publications and of the people being promoted on the basis of their scientific production. Organizing workshops and special sessions is essential for fostering the wide exchange of information and views on scientific topics of interest. At times, these activities can be exacting and even unpleasant when unavoidable conflicts with authors arise, but I believe it is a price worth being paid. I strongly encourage the new scientist generation to invest quality time in these activities since it will benefit their careers and the welfare of their community.

Q. What conferences do you attend besides IEEE-sponsored meetings?

Marika: Most of the conferences of interest in my field are indeed sponsored and organized by IEEE. I try to be selective in deciding which meeting to attend for lack of time. Besides large conferences like CDC, I like to attend smaller meetings such as workshops focused on my areas of interest where the exchange of information and ideas is more fluid. For example, I enjoy participating in the Hybrid System Computation and Control (HSCC) Conference, which offers a great opportunity for discussion and exchange of research ideas between two different scientific disciplines.

Q. What are some of your interests when you are not involved in research and teaching?

Marika: My favorite time is with my daughter Maria and son Marco, watching a movie, strolling in our beautiful city of Rome, or traveling to new places. I love music, and I play piano. It is so much fun when I accompany my son when he plays violin! I enjoy reading modern and classical literature. Recently my sister, Gabriella, who is a university professor in telecommunications and with whom I also have exciting conversations about our research work, gave me a book on yoga. I discovered the many facets of this discipline, which is not only concerned with relaxation, but with strength and control… this may be the reason why I like it so much! As a matter of fact, what if our "transient" versus our "steady-state" response was a manifestation of the enlightening Zen motto: "it's not the destination… it's the glory of the ride…."

Q. Thank you for speaking with *CSM!*

Marika: You're most welcome.

SANDOR VERES

Q. You've worked on a wide range of systems and control problems. Is there some kind of unifying theme to your interests?

Sandor: Perhaps the most lasting theme of my research is a tendency to address problems that are underresearched while practically important when I come across them. I rarely join a "bandwagon," and to be honest this attitude definitely does not come to my advantage. Information theory and structure selection of stochastic systems and parameter estimation was my first interest. When I joined the research of bounding techniques it was in its infancy, foundations were being laid down, but new results still appear today; I am editing a journal special issue on this topic right now. I created a basic bounding toolbox that is easy to use in Matlab. My follow-on topics have been robust adaptive control, active control of sound and vibration, formation flying of satellites, and now agent-based control of autonomous systems. Active sound and vibration control will thrive again when cheap miniaturized actuators and sensors become available. I have also developed an interest in and worked on a special technique of robust adaptive control that is very powerful and has a generic underlying scheme to it in terms of how we do science.

Sandor Veres, with his wife Galina and their son David on the shore of Southampton Water near their house.

During this diverse experience I have gradually realized two things. First, however good our individual results are, our contributions are a "drop in the bucket" if not in the ocean. Second, these individual algorithmic modeling and control results could be directly communicated to

Digital Object Identifier 10.1109/MCS.2010.937868

I believe the synergy between identification and control could be further explored in theory and in practice.

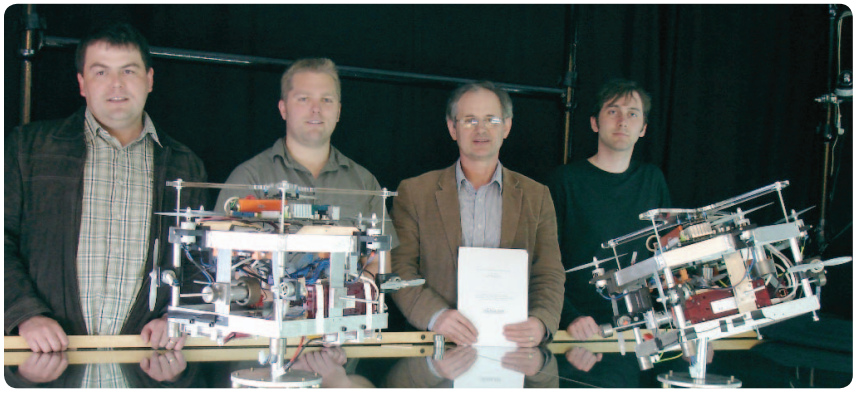
software agents that supervise the control of a machine in manufacturing, onboard vehicles, and utility systems. This second realization was helped by my early interest, as a student and shortly after, in mathematical logic, information theory, conceptual graph theory, and machine "intelligence." I have always held these areas close to my heart. That is why I have recently entered research on formal verification of complex autonomous systems. My motivation is again that of practical importance: these procedures are instrumental for legal certification of vehicle, healthcare, and manufacturing robots. This directly led to my interest in formalization of transferable machine knowledge. I believe this formalization must be done in the simplest of ways so that it is easily accessible to all engineers, regardless of their training. This cannot be said about most knowledge-engineering projects for the semantic Web today. I am now excited about the prospect of spreading some fundamental solutions to this problem.

Q. What is the Geometric Bounding Toolbox used for?

Sandor: The Geometric Bounding Toolbox for Matlab was created to provide an easy-to-use set of routines to perform computations with polyhedral sets, polytopes, ellipsoids, cylinders, and nonconvex sets. It is used by engineers worldwide to compute with constraints in state or input space. It is also used by font typesetters to compute ink volume for complex fonts, by cartographers who produce three-dimensional models of the world, roboticists, biologists, and medical researchers. It is not generally known that its unique feature is error control in floating point computations with respect to vertex-plane fits.

Q. You've written two books on system identification. What are some of the current challenges of that field?

Sandor: There is a lot of interesting research actively pursued today that I hope will continue and enrich our algorithmic capabilities to derive dynamical models from data. Just to mention a few: model structure selection and parameter identification of general nonlinear models; modeling error quantification for small data samples; identification of hybrid system structures and their parameter estimation; and encoding of models into memory for fast real-time recognition from data in fault diagnosis modules. Also I believe the synergy between identification and control could be further explored in theory and in practice. I would like to mention a new challenge arising from my current interests in intelligent agents. System identification can be reinterpreted as an agent's ability to learn dynamics from data. Can you imagine an intelligent robot doing system identification? In fact, rational deliberative agents can be made aware that dynamical models can help their ability to predict the future. They can use models to design a feedback controller to regulate a variable of the environment. Such reasoning agents can be easily defined in our Cognitive Agent Toolbox developed with my colleagues at Southampton. These agents can learn procedural knowledge from English technical papers on system identification written by researchers in "system English." So what about publishing papers for colleagues as well as for robots? These papers can, for instance, be published as Web pages to make them easily accessible to agents. I am not suggesting that we are at the stage that human skills and ingenuity in system identification can be replaced by agents soon. I am just saying that an autonomous agent's knowledge of dynamical modeling may help rescue a mission in deep space, on distant planets, deep in the oceans, or, closer to ground, in robotic systems on Earth. Such knowledge transfer from humans to agents is of course not limited to system identification or control; a lot of engineering knowledge can also be transferred.



Sandor among colleagues in the satellite section of their Autonomous Vehicle Systems Laboratory. From left: Postdocs Levente Molnar and Nick Lincoln, Sandor Veres, and Ph.D. student Colin Morice.

Q. Please talk a little more about "system English" and some of the ideas in your new book *Natural Language Programming of Agents and Robotic Devices*.

Sandor: I have invented natural language programming, such as NLP, as probably the simplest way to conceptualize algorithmic knowledge for an engineering application. The one based on English is called "system

English," or sEnglish for short. You define the meaning of a sentence by a sequence of other sentences until you arrive at sentences that are subconscientious from an agent's point of view and you define their meanings by either a Matlab, ADA, or C++ code. Basic concepts must be defined in an ontology. You obtain a rigid system of sentence meanings that uniquely compile to computer code, thus preserving the greatest achievement of the digital computer: determinism. Can you imagine a book that can also be read by simple robots? An sEnglish book with contents, sections, and subsections defines a web of deterministic meanings and also a set of sentences at higher levels of abstractions that explain the usefulness of the knowledge described in the book. sEnglish books can be published by experts in a given area and can be read by nonexperts and used by a large class of intelligent agents to learn "skills." These software agents can vary in complexity from reactive to multilayered, complex, and sophisticated deliberative rational agents. Such agents could control processes in manufacturing, autonomous vehicles, cooperatively regulate utility networks or could provide comfort control in our homes. More information can be found on www.system-english.com. I am working with several universities in the United Kingdom to build up a skills library for agents using sEnglish books.

Q. You're involved in experimental projects. Do you find these beneficial for developing new ideas and methods?

Sandor: In recent years experimental projects have been vitally important for me as they revealed problems that are essential to address by theory: for instance, the importance of experience-based knowledge as well as analytical knowledge for rational agents that control my laboratory vehicles: rovers, 5DOF model satellites, UAVs, and AUVs. Using real hardware, even if it is only in a laboratory environment, can bring up issues with speed of computation, the need for parallel processes and processors, or the importance of a middle layer between sensors and logical reasoning that produces a network of abstractions for agents to rely on. I also enjoy designing and building real things and finding mechanical and electronic solutions.

Q. What kinds of courses do you teach? Do you have a personal philosophy of education?

Sandor: At the moment I teach third- and fourth-year courses for undergraduates and M.Sc. students, one on classical control that includes state-space methods and the fundamentals of nonlinear control, another course on advanced digital control that introduces students to the basics of satellite control, aircraft control, process control, vibration and sound control, and car control systems. I also teach avionics to introduce students to the principles of design specifications, design processes, and computing architectures onboard modern aircraft, including safety redundancy and fully distributed control systems with time-triggered protocols that are spreading in the aircraft industry. My philosophy to teaching is simple: transfer my interest and enjoyment of a topic on well-selected examples, and leave the details to homework.

Q. What are some of your interests outside of research and teaching?

Sandor: I am lucky to live by a pebble beach and a pitch and putt course along Southampton Water. From April to October it feels like living in a holiday resort as people drive there to relax. My favorite sports are jogging, cycling along the shore, and sailing. I regularly go skiing in France or Austria during the winter. I am also a member of a local book club.

Q. Thank you for speaking with *CSM*!

Sandor: You're most welcome.