

Horizons in Infinite-Dimensional Deterministic and Stochastic Systems

A WORKSHOP IN HONOR OF A.V. BALAKRISHNAN

On January 30–31, 2009, a workshop sponsored by the National Science Foundation was held in honor of A.V. Balakrishnan. The workshop focused on topics that constitute Balakrishnan's research legacy— infinite-dimensional systems theory, control of partial differential equations (PDEs), and stochastic systems. The workshop was organized by Miroslav Krstic (University of California, San Diego, UCSD) and Irena Lasiecka (University of Virginia) and hosted by the Department of Electrical Engineering at University of California, Los Angeles (UCLA).

A.V. BALAKRISHNAN

A.V. Balakrishnan was born in 1922. He received the M.S. degree in cinema in 1949, the M.S. degree in electrical engineering in 1950, and the

Ph.D. degree in mathematics in 1954, all from the University of Southern California. He worked at RCA's Space Technologies Laboratories from 1954 to 1961. He joined UCLA in 1961 as associate professor and was promoted to full professor in 1962. He served as the founding chair of the Department of Systems Science at UCLA from 1969 to 1975 and again from 1980 to 1983. During his career at UCLA he graduated 52 Ph.D. students, authored 80 journal articles, of which 75 are single-authored, and authored or co-edited ten books, including his classic *Applied Functional Analysis*. He was elected Fellow of IEEE in 1966 and received the Richard E. Bellman Award in 2001. He has made seminal contributions



A.V. Balakrishnan at the workshop.



Tom Kailath offers his remarks in tribute of A.V. Balakrishnan.



Jason Speyer presents results on state estimation of systems subject to Cauchy noise. This talk was followed by a lively discussion with Balakrishnan.

to stochastic systems, optimal control, infinite-dimensional systems theory, aeroelasticity, and other fields.

CONFERENCE WORKSHOP

The workshop drew over 70 attendees from 26 universities, including three overseas participants as well as junior researchers and graduate students from engineering, mathematics, and control programs in southern California. Opening remarks were delivered by UCLA Dean of Engineering Vijay Dhir, Electrical Engineering Department Chair Ali Sayed, and Kishan Baheti



Participants of the workshop in honor of A.V. Balakrishnan.

Digital Object Identifier 10.1109/MCS.2009.932551



Panel discussion on future directions of the field with (from left) Tyrone Duncan, George Avalos, Wolfgang Lubner, David Russell, and Sanjoy Mitter.



Sanjoy Mitter, Vijay Dhir, and Andrew Viterbi enjoy the reception.



David Russell responds to a question on stationary stabilization of elliptic PDE systems, such as in ground water management.

of the National Science Foundation. The workshop consisted of 27 technical talks by invited speakers, of which nearly half are junior researchers, a panel discussion on future directions of the field, and a session in which Claude Benchimol (former Ph.D. student), Thomas Kailath, Ronald Mohler, Andrew Viterbi (former junior faculty colleague), and Don Washburn (former Ph.D. student) presented remarks on Balakrishnan's impact in the field or on their careers. Ron Mohler presented a retrospective of photographs, reviewing Balakrishnan's career and international influence and collaborations, with an emphasis on the period from the late 1960s until the early 1980s.

On the first day of the workshop, lectures were presented by S. Mitter, D. Russell, K. Malanowski, F. Udwadia, J. Speyer, N. Levan, R. Trigiani, M. Krstic, W. Lubner, L. Tebou, and A. Tartakovsky on topics that include nonlinear estimation, sensitivity analysis, mechanical and structural systems, Cauchy noise, wavelets, coupled PDEs, delay systems, and flutter. On the second day of the workshop, J.-P. Zolesio, T. Duncan, G. Avalos, Q.-P. Vu, M. Shubov, P. Wang, C. Preda. E.

Cerpa, D. Toundykov, S. Liu, L. Bociu, A. Tuffaha, J. Zhang, C. Lebedzik, and E. Schuster spoke on a variety of topics such as Euler flows, fractional Brownian motion, fluid-structure systems, controllability of Korteweg-de Vries (KdV) equations, stability of nonlinear wave equations, and infinite-time averaging for Itô systems, as well as application-driven topics such as tokamak fusion, carbon nanotubes, and atomic force microscopy (AFM).

CLOSING REMARKS

The workshop concluded with a panel discussion addressing future directions of PDE control systems, stochastic control, and their applications. The panelists included George Avalos, University of Nebraska, United States; Tyrone Duncan, University of Kansas, United States; Wolfgang Lubner, EADS, Germany; Sanjoy Mitter, Massachusetts Institute of Technology (MIT), United States; and David Russell, Virginia Tech, United States. The discussions, which were moderated by Miroslav Krstic and Irena Lasiecka, focused on the challenges facing theoretical research in the

context of increasingly complex systems involving numerous interconnected PDEs, such as in biology; the role of single-investigator idea-driven research versus team- and MURI-style research; and the changes in the landscape of the field of PDE control over the last ten years, where the focus has shifted from elastic systems and aerospace applications to fluid flows, Navier-Stokes systems, and nonlinear PDEs, and toward methods that are suitable for addressing adaptive control questions for PDEs.

A grant from the National Science Foundation provided support for travel and local expenses for 22 junior researchers, graduate students, and invited speakers. Organizational support was provided by Paulo Tabuada (UCLA-EE), Eduardo Cerpa (UCSD), the Department of Electrical Engineering at UCLA, and the Cymer Center for Control Systems and Dynamics at UCSD. Complete information on the workshop, including the final program and the abstracts of the talks, is available on the workshop Web site <http://flyingv.ucsd.edu/workshop-bal/workshop.html>.

Miroslav Krstic