Across the Board

It's rare to have a single issue of *IEEE Control Systems Magazine* (*CSM*) in which the feature articles span so many of the most important and crucial topics in our field. In this case, I'm referring to software, energy, and biology.

Recently, the U.S. Air Force released "Report on Technology Horizons, a Vision for Air Force Science & Technology During 2010–2030." This report includes the following "essential insights":

> Greater use of highly adaptable and flexibly autonomous systems and processes can provide significant time-domain operational advantages over adversaries who are limited to human planning and decision speeds; the increased operational tempo that can be gained through greater use of autonomous systems itself represents a significant capability advantage.
>
> Achieving these gains from the use of autonomous systems will require developing new methods to establish "certifiable trust in autonomy" through verification and validation (V&V)

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Contributors

Eric Feron in teaching mode.

Wenxue Wang on the Pacific coast near UCSB.

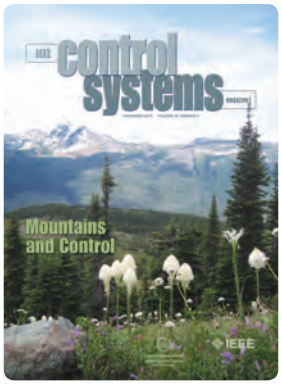
Robert Griñó and his wife Yolanda in the desert of Wadi Rum, Jordan.

Antonio Sánchez-Squella and his wife Maria-Isabel at Huilo-Huilo Falls, Chile.

Anant Sahai hiking in Maui with his wife Shubhra.

Shane Malo visiting Toledo Spain.

of the near-infinite state systems that result from high levels of adaptability; the lack of suitable V&V methods today prevents all but relatively low levels of autonomy from being certified for use.



Developing V&V methods for highly adaptive autonomous systems is a major challenge facing the field of control science that may require a decade or more to solve; the Air Force, as one the greatest potential beneficiaries of such systems, must be a leader in developing the underlying science and technology principles for V&V.

This inexorable logic, from the advantages of autonomy to the need to verify and validate software for control systems, provides a backdrop to the first feature article in this issue of *IEEE CSM*. In "From Control Systems to Software," Eric Feron shows how tools from computer science can be used in conjunction with control-theoretic ideas to develop software with "certificates" that support validation and verification.

In the area of energy, the article "Dynamic Energy Router" by Antonio Sánchez-Squella, Romeo Ortega, Robert Griñó, and Shane Malo develops techniques for transferring energy among electrical subsystems. This technology is crucial to interconnected power systems involving energy-storage devices, transmission lines, and electromechanical devices.

In the area of biological systems, the article "High-Throughput Biological Data Analysis" by Thanura R. Elvitigala, Ashoka D. Polpitiya, Wenxue Wang, Jana Stöckel, Abha Khandelwal, Ralph S. Quatrano, Himadri B. Pakrasi, and Bijoy K. Ghosh discusses techniques that are available for obtaining data about DNA and RNA as well as systems tools that can be used to determine interactions among genes. This article shows the strengths and limitations of each measurement technique and discusses statistical methods for determining the gene or genes that control the cell properties of interest.


Robert Griñó and his wife Yolanda in Ait Benhaddou, Morocco.


Polpitiya Ashoka.


Himadri Pakrasi.


Thanura Elvitigala at Lake Erie.


Bijoy Ghosh.


Ralph Quatrano in his lab at Washington University.


Wendy and Jeremy West.

Eric Feron with (from left) his wife Christine-Marie and daughters Lucile and Julie near Jackson Hole, Wyoming.

Silvia Bardi at a Swiss lake.

Pulkit Grover hiking on the Big Island of Hawaii.

Eric Feron at the controls of a Boeing 777 simulator.

Kristin and Jeff Humpherys.

Silvia Bardi and her son Matteo Navid in Zurich.

Jana Stockel.

The "Applications of Control" column in this issue is an article by Silvia Bardi and Alessandro Astolfi on the contribution of control techniques to waste incineration. This application involves stringent operational conditions mandated by the EU and thus represents a crucial and challenging application of control technology under limited measurement and uncertainty.

To conclude the 50th anniversary celebration of optimal stochastic estimation, this issue brings another tutorial article on the Kalman filter. In "Lecture Notes," Jeff Humpherys and Jeremy West show that Newton's method provides a convenient foundation for this result.

This issue includes an obituary of Israel Gohberg, whose mathematical contributions touched numerous facets of the control theory enterprise. We also bring you four "People in Control" interviews, a technical committee report on discrete-event systems, the usual cohort of book announcements, four conference reports, and a suggestion for making highways safer, at least for those who drive responsibly.

As we close 2010, I look forward to the exciting developments and advances that our field of endeavor has to offer.

As we close 2010, I look forward to the exciting developments and advances that our field of endeavor has to offer. It's hard to imagine a Society with more diverse yet common interests. I look forward to your contributions on all aspects of systems and control science and technology. See you in 2011!

Dennis Bernstein