

Brick by Brick

Imagine that you need to assemble a structure, such as the one depicted on the cover of this magazine. The pieces would need to be joined together, one at a time, until the structure is complete. To do this, you would choose a starting point and then add one piece at a time. You might find out, however, that, as you assemble the structure, some kind of external support is needed since the intermediate structures are not as rigid as the completed structure. You might wonder, then, whether there is a way to assemble the structure so that all of the intermediate structures are inherently rigid. The reverse problem is also of interest: How do you take

the structure apart so that it doesn't collapse in the process?

These assembly and disassembly problems are a metaphor for the augmentation and reduction of formations, which Brian Anderson, Changbin Yu, Baris Fidan, and Julien Hendrickx discuss in this issue of *IEEE Control Systems Magazine (CSM)*. In particular, they consider the problem of adding nodes to a formation so that, after each modification, the resulting formation maintains rigidity. Rigidity means that the formation cannot be continuously deformed while satisfying the formation's internode distance constraints.

A formation may be minimally rigid, or it may have redundancy in the

sense that rigidity persists even when some nodes are removed. Therefore, during reduction, the removal of a single node may or may not destroy rigidity. A more extreme form of reduction is to decompose the formation into two separate multi-node formations. The problem then is to determine how to perform this decomposition so that each of the resulting formations is rigid. Remarkably, there are powerful tools and methods—some classical and some recent—for all of these problems. The subject is fascinating, and many of the results are surprising.

In this issue, we also continue the special section on modeling systems with friction, the first installment of which appeared in the October 2008

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Contributors



Avraham Harnoy (left) and Bernard Friedland.



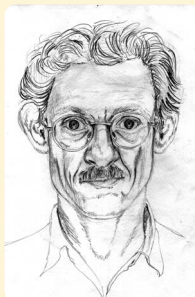
Brian Anderson and Changbin (Brad) Yu at Tianmen Cave in Zhangjiajie, China before the 2007 CCC.



Baris Fidan during a visit to Brussels.



Josh Bishop



A self-portrait of Farid Al-Bender.



Farid Al-Bender and Marina Van den Branden with their children Idries, Noor, and Hanna.

issue. The first article in this follow-on section, by Farid Al-Bender and Jan Swevers, presents a large-scale approach to friction modeling in which small-scale asperities combine to replicate the effects of friction on a macroscopic level. Next, the article by Avraham Harnoy, Bernard Friedland, and Simon Cohn discusses a technique for measuring the effects of friction to validate a postulated friction model. In a different direction, the article by Y. Guo, Zhihua Qu, Yehuda Braiman, Zhenyu Zhang, and Jacob Barhen considers physics-based models for friction that mimic molecular interaction. Finally, the article by Karl Astrom and Carlos Canudas-de-Wit discusses properties of the Lund-Grenoble (LuGre) friction model.

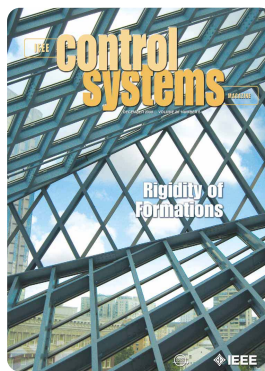
In "Applications of Control," we have an article on friction modeling for part placement, which is needed for assessing manufacturing accuracy. This department also includes an application of the minimum-variance smoother to the control of machines for coal-mine automation.

For "People in Control" we speak with two journal editors, Jie Chen

and Brett Ninness, who are editors of new and established control journals, respectively. We also speak with Tariq Samad, who is well known to CSM readers as a past editor-in-chief of this magazine and will soon begin a term as president of IEEE Control Systems Society (CSS).

But that is not all. For "Historical Perspectives," we have an autobiographical essay by Jurgen Ackermann, who relates his experiences in the control field and shares some valuable advice. We also have four book reviews and two conference reports, and we end with a long overdue pun.

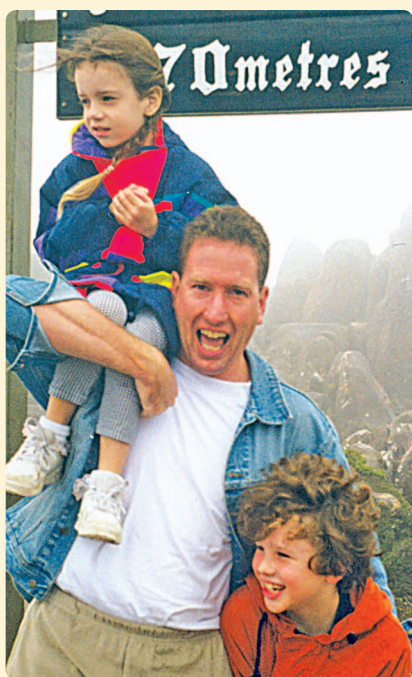
Since this is the December issue, I'll close with a few end-of-the-year thoughts. First, I see the coming year as auspicious on many levels, from the many new projects that CSS is embarking on to exciting developments in the diverse areas in which CSS members



are active. CSM is working on numerous special projects, ranging from automotive safety to hybrid systems to Kalman filter applications. The scope of control technology continues to expand into new and challenging fields. Finally, the CDC—the CSS flagship conference—will be held soon in Cancun, Mexico. This is the

ideal venue for meeting others in the field, exchanging ideas, and learning about recent developments. During the conference, I hope to hear about your ideas for either long or short articles for future issues. If you cannot attend, then e-mail is always welcome, but my first choice is to hear your ideas in person. Finally, please be aware that the 2009 CDC to be held in Shanghai, China, necessitates an earlier-than-usual submission deadline, so be sure to check the conference Web site ASAP. Happy New Year!

Dennis S. Bernstein



Chloe, Garry, and Jak Einicke.



Garry Einicke



Laine Mears and his daughters Marina (left) and Maddie May.



Julien Hendrickx visiting Niagara Falls.



Yi Guo with her mother Zhenfu Liu (left) and her son Raymond (center).