

Guest Editorial

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Few of us who lived through the introduction of personal computers near the end of the last millennium were ready to grasp the huge impact that these devices would have on so many diverse aspects of life— ranging from entertainment to problem solving -- and far beyond. Revolutionary changes due to computers are everywhere in our lives and in our ways of doing things. Close-up for me are the mutating worlds of technical publishing and the distribution of knowledge in this new age of digitized information. All of us know that the more-than-three million articles stored on Xplore, for example, can be shared efficiently with researchers across the globe. However, Xplore can do more than speedily provide printable copies of its stored articles. I was impressed to see this point made very clearly in an editorial recently written by my colleague at Berkeley, Professor Ken Goldberg. Ken is Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering. With his permission, we reprint Ken's editorial below

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Editor-in-Chief : IEEE/ASME Journal of Microelectromechanical Systems

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A Secret to Advancing Research and Increasing Citations to Your Papers

Editorial, July 2012: IEEE Transactions on Automation Science and Engineering

I recently discovered a straightforward way to advance research in almost any field. It's free and requires almost no extra work by researchers. There's more: it can also increase citations to your papers. I call it a "secret" because surprisingly few authors are using it.

What I mean by advancing research is: enhancing reproducibility of results. A core value of science is reproducibility. The scientific method relies on researchers being able to reproduce each other's results, first to verify them, and second to build upon them. To facilitate this, researchers in most fields publish papers with sufficient detail to allow reproducibility. But even with a detailed description, it can be very difficult to reproduce an apparatus, obtain the right materials, and accurately measure the resulting data so that alternative models and theories can be compared. A method that can accelerate those steps would advance research in almost any field.

Here's the secret: when you submit a paper, include "supplemental material" – datasets and display macros (ideally in a common format like csv or xls), code/software for data analysis and simulation, and if relevant, detailed drawings, 3D CAD models, photos, videos, slideshows, tutorials, and anything else that may be useful to fellow researchers. After review, if the paper is accepted, these files will be available via IEEE Explore next to the link for the paper.

Including supplemental material can *enormously* lower the barriers to reproducibility for other researchers, such as graduate students who are looking for interesting topics and established researchers who can expand on your results (including many in developing countries who may not have the resources to build hardware but have strong analysis and modeling skills).

Since 2005, IEEE publications have permitted authors to include such supplemental material when a paper is submitted. See details under “Submission of Multimedia Material” on this website: www.ieee-ras.org/tase/authorinfo .

Most publishers, including IEEE, do not charge for including supplemental material. Public funding agencies encourage sharing of such information. It is consistent with the larger “open-source” trend that encourages sharing of data, images, lecture notes, and other resources in addition to code. Authors generally have a great deal of such supplemental material at the time of publication, so this requires very little extra work on their part.

There’s another benefit. With recent advances in online citation services such as Google Scholar, the “publish or perish” imperative is being enhanced with new tools that track the “impact” e.g. the citation count of an author or paper in real time. Google Scholar now allows authors to receive detailed reports on citations to their papers along with quantitative metrics such as h-index, and even instant alerts each time one of your papers is cited (see scholar.google.com).

Call this *Goldberg’s Conjecture*: a paper that freely includes its data, code/software, and other material like videos, slides, photos for instant download is much more attractive to study and build on and hence more likely to be cited. I’d welcome a careful scientific study of this conjecture. All we need is a good set of papers that include supplemental material to do the comparison.

Alas! Among T-ASE papers published in 2011, *not a single paper* included supplemental material! (Among papers published in 2011 by the IEEE Transactions on Robotics (T-RO), fewer than one in five included such material). My thanks to Wolfram Burgard, Alessandro De Luca, Gregory Dudek, David Hodges, Vijay Kumar, Peter Luh, Matt Mason, Daniela Rus, and Sanjay Sarma for feedback on this issue.

I’m hoping more authors consider taking advantage of this option and spread the word among colleagues and students so that it is no longer a secret. It’s much easier to stand on the shoulders of giants if the giants share their data, and their code.

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