Publications beyond papers: the future is now!

Since the origins of science, the main output of researchers has been books and papers that describe new theoretical and practical ideas and results. Books and papers are useful and important, but learning from them is often not easy. How can we facilitate this learning process?

This is not a minor problem, this is a crucial issue. One of the main objectives of science is to help make human lives easier through practical applications. We want practitioners to pick up and implement our ideas and techniques. And if we academics have trouble understanding the papers, imagine how difficult it is for practitioners. It is not accidental that many practitioners feel that publications' accessibility needs improvement.

To provide possible solutions to this problem, let us recall what helps us understand not-easy-to-understand papers. Often, what helps is attending a seminar or a conference talk -- this is one of the main reasons why many of us attend conferences instead of simply reading the conference proceedings. At a talk, in addition to the technical stuff from the corresponding paper, we often have detailed motivations and reminders, we have pedagogical examples that help us understand, we sometimes have videos clarifying the material, we have slides that provide a useful compressed description of the paper, and we have the talk itself.

Another way to better understand the material is to attend a related tutorial (and/or, if available, to read the related sections of a textbook). In a tutorial, derivations are given in detail. This may be sometimes boring, but it clarifies how each formula is derived.

Finally, we always have the option of asking the authors, in person at a talk or by email if needed. We can ask the authors for details of their derivations, we can ask them for an explanation of why the problem is of interest, we can ask them for details of how their data processing supports their conclusions.

This all helps, but it is not a panacea: it is not physically (or financially) possible to attend all interesting conferences, and while the authors' replies help, even the most generous and helpful authors can only answer so many requests.

A natural idea is to add all this supplementary information to the paper: slides, data, detailed motivations, detailed derivations, videos, etc. Of course, papers are limited in length, so we cannot include all that in the paper itself. Besides, not everyone needs all this: a practitioner will probably be more interested in details of an algorithm and not so much interested in how the corresponding formulas were derived, while a theoretician working on a similar problem may be most interested in the details of the derivation. Since we cannot place all this additional material into the paper itself, let us place it into supplements.

So, a solution is to add supplements to academic papers, supplements that include slides, data, detailed motivation, detailed derivations, videos, other multi-media stuff. These supplements will make academic papers more accessible and boost application of our ideas and techniques.

Some readers may say: nice vision of the future, but IEEE is more down-to-Earth. However, this is already possible, this future is already here!

The ideas of using paper supplements can be traced back to Einstein who was one of the first (and maybe *the* first) to use them. In the 1930s, when Einstein was studying the effect of General Relativity on celestial mechanics, his first derivation of the corresponding equations of celestial mechanics required several

hundred pages -- too much for a journal publications and too boring to place in a book. So, after reviewers checked that all the derivations were correct, he published a reasonable-size paper containing only the resulting equations[1] and stored the pages with the detailed derivations in the library of the Institute for Advanced Studies, where anyone could request an access.

Of course, in the old days, before the Web, access to such deposited material was not easy. Now that most information is available on the web, the access to online supplements is easy (and immediate). Many journals, such as "Nature", do exactly this: they print a short paper and place details of derivations and/or data details in an online supplement that anyone interested can access.

The good news is that IEEE Xplore enables us to do it as well: we can supplement a paper with additional materials such as slides, details of derivations, detailed motivations, pedagogical examples, computer code for resulting algorithms, data, multi-media illustrations, whatever we want. All this, of course, has to be submitted for review simultaneously with the paper itself, to make sure that the supplements are correct and understandable.

The only limitations now are: the supplement size is limited, and all the supplementary material is stored as a zip file, so we need to unzip it before accessing (two clicks instead of one :-).

Some IEEE conferences already add recorded presentations (slides and synchronized voice) to the Xplore publications, some IEEE journals allow multimedia supplements and data sets (unless they are too huge). Appendices with technical details are also sometimes used. But, all this is under-used.

Let us use these features -- and thus, let us help our ideas and methods to be easier to understand and thus easier to implement. Let us make sure that the future is indeed now!

Vladik Kreinovich

Vice President Publication, IEEE SMC Society

University of Texas at El Paso, vladik@utep.edu

[1]A. Einstein, L. Infeld and B. Hoffmann (1938) "The Gravitational Equations and the Problem of Motion", Annals of Mathematics, Second series 39 (1): 65–100.