

# Optical Engineering

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## More Than a Paper

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## More Than a Paper

In addition to providing new and significant theoretical or experimental results to advance a field of study, an important standard for scientific journal publication is that the results are reproducible. In order to support this potential for reproducibility, authors are expected to provide sufficient details of their experimental methods, including data, procedures, and results, such that peers can attempt to reproduce the published results based on the information contained in the publication and other available references. This not only allows independent verification but also further exploration down successful lines of scientific investigation by the broader community. It is an important tradition of scientific study that enables its expansive growth and advancement.

This longstanding tradition is challenged in today's information age where scientific study is often characterized by complexity, frequently leveraging and producing massive amounts of data. Experimental methods regularly employ extensive computer software for equipment control, processing algorithms, and data analytics, with novel aspects of the scientific development captured in the data and computer software themselves, making it difficult to convey in a traditional manuscript format comprising text, tables, and figures. Reproducibility may sometimes be realistic only with access to the raw data and computer code, and authors may need more than a published paper to completely convey their work.

Recent government regulations, particularly within the United States, have raised the bar with respect to open access to the results of scientific research. In its 2013 directive,<sup>1</sup> the White House Office of Science and Technology Policy (OSTP) requires federal agencies with more than \$100M in research and development funding to make the direct results of their research publicly available to the "greatest extent and with the fewest constraints possible and consistent with law." This not only includes published manuscripts, which can be addressed through open access journals, but also data pertaining to scientific results. The latter can place a burden on research performers.

These trends in scientific research have driven some journals to adopt policies and infrastructure to allow authors to include supplemental material in conjunction with published papers. Such supplemental materials are contained within repositories maintained by the journals, are accessed through

online links, and can be in the form of tables, videos, images, and text in a variety of standard formats. This practice has become somewhat prevalent in *Science*, *Nature*, and medical journals, allowing the published papers to remain short and concise, while providing access to all other essential data and information to peer researchers desiring more insight into the published work.

Allowing supplemental information in journals is not without problems and limitations. There is a perception by some that authors are using supplemental material to circumvent journal page limits and costs, placing otherwise essential information in the supplement. Supplemental materials can also become a data dump, driving journals to expand databases to accommodate the additional material. An exponential increase in storage requirements after adopting the practice is one reason cited by the *Journal of Neuroscience* for ultimately discontinuing it.<sup>2</sup> While there is general consensus that supplemental materials should be reviewed as part of the main paper, it is doubtful that this regularly occurs as it can be taxing on reviewers.<sup>3</sup> Finally, allowable supplemental data formats do not generally support a wide variety of data types, such as hyperspectral imagery, laser radar data, and executable computer code.

The SPIE Board of Editors has been considering the possibility of allowing supplemental figures, tables, videos, and text (lengthy mathematical derivations and experimental details) to be included with published papers for some SPIE journals, potentially including *Optical Engineering*. Reviewers would be asked to assess the necessity of including the supplemental materials but will not be expected to thoroughly assess the material itself. I have been considering whether the adoption of this practice would be beneficial to *Optical Engineering* authors and readers, and whether the benefits would outweigh the difficulties experienced by other journals.

There are two avenues available to *Optical Engineering* authors that already address some of the needs that supplemental materials are intended to address. The first is the coupling of journal papers with SPIE conference proceeding papers. As I have mentioned in previous editorials, *Optical Engineering* papers derived from conference proceedings papers average higher download and citation rates than regular papers that are not. They raise the quality of our journal. A common practice for some of these authors is to publish preliminary results in conference proceedings, and then publish their more complete work in *Optical Engineering*. This provides authors the opportunity to keep their journal paper more concise and focused on the significant advances, while citing the supporting conference proceedings that contain lower-level details. As this material is accessible to readers, it obviates the need for a supplement.

The second avenue concerns computer software that can form an important part of the published work. Access to computer code can be incorporated in published journal articles by links to Code Ocean, a cloud-based computational reproducibility platform recommended by SPIE,<sup>4</sup> or other similar repositories such as GitHub.<sup>5</sup> Code Ocean supports ten programming languages, allowing readers to access and execute published code with new input values, giving them the ability to not only reproduce the published results but also to extend beyond them.

At this point, an important type of supplemental material not fully addressed by current supplemental material practices is raw digital data beyond common spreadsheet, image, and video formats. Authors sometimes provide links or other means of access to repositories containing supporting data, but these are not always well maintained. I anticipate that the need to provide access to well-maintained repositories for such data will continue to grow in the future, and perhaps this is a service SPIE should seek to provide.

**Michael T. Eismann**  
Editor-in-Chief

### References

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