Optical Engineering

SPIEDigitalLibrary.org/oe

Impact Factor and Other Journal Metrics

Ronald G. Driggers

SPIE

Impact Factor and Other Journal Metrics

I have always wondered whether the impact factor was a reasonable metric to describe the journal performance of *Optical Engineering*. This month, I have had some pretty good discussions with SPIE staff and some of the other SPIE journal editors about the topic.

For those of you who are not familiar with the impact factor, it is described on the Thomson Reuters site (http://thomsonreuters.com/products_services/science/free/essays/impact_factor/) as follows:

> The impact factor is... a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period. The annual impact factor is a ratio between citations and recent citable items published. Thus, the impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years.
>
> A = total cites in 1992
>
> B = 1992 cites to articles published in 1990–91 (this is a subset of A)
>
> C = number of articles published in 1990–91
>
> D = B/C = 1992 impact factor
>
> The impact factor is useful in clarifying the significance of absolute (or total) citation frequencies. It eliminates some of the bias of such counts which favor large journals over small ones, or frequently issued journals over less frequently issued ones, and of older journals over newer ones. Particularly in the latter case such journals have a larger citable body of literature than smaller or younger journals. All things being equal, the larger the number of previously published articles, the more often a journal will be cited.

In addition to a few of the issues described above, I have wondered whether impact factor is a good metric for *Optical Engineering* because in general engineers do not publish their work as often as basic scientists or medical researchers, and when they do, the number of cited references tends to be lower than citations in papers written by those in science and medicine. Thus, those who do publish their work are generally not cited as often as authors in other occupations. Maybe the number of downloads would be a better metric. I know many optical engineers who download papers and use the results, but they do not publish themselves. Also, impact factor does not take into account the number of readers and the amount of circulation, so that larger journals that make a larger difference with their constituents are not given credit for a large following. Finally, how long a journal has been around is not counted in impact factor, so papers that are older but are still generating citations do not contribute to the metric.

I think things are changing. Many organizations use the *h*-index as a metric to describe the productivity and impact of their researchers. Wikipedia describes the *h*-index as follows:

> The *h*-index is an index that attempts to measure both the productivity and impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The index can also be applied to the productivity and impact of a group of scientists, such as a department or university or country, as well as a scholarly journal. The index was suggested by Jorge E. Hirsch, a physicist at UCSD, as a tool for determining theoretical physicists' relative quality and is sometimes called the Hirsch index or Hirsch number.
>
> The index is based on the distribution of citations received by a given researcher's publications. Hirsch writes:
>
> > A scientist has index *h* if *h* of his/her N_p papers have at least *h* citations each, and the other $(N_p - h)$ papers have no more than *h* citations each.
>
> In other words, a scholar with an index of *h* has published *h* papers each of which has been cited in other papers at least *h* times. Thus, the *h*-index reflects both the number of publications and the number of citations per publication. The index is designed to improve upon simpler measures such as the total number of citations or publications. The index works properly only for comparing scientists working in the same field; citation conventions differ widely among different fields.

My *h*-index can be determined from the graph in Fig. 1. My highest cited publication was cited almost 120 times. My next publication was cited 75 times and so on. If publications are sorted in order of number of citations, the *h*-index value occurs where the publication number equals the number of citations. In my case, my *h*-index is around 18. This is not a bad number for an engineer with many years of experience. Scientists with comparable longevity often have higher *h*-indices. So, what gives a researcher a high *h*-index? Someone who publishes a good number of papers where the papers are highly cited will have a high *h*-index. The *h*-index goes up with researcher age and full professors are expected to have higher *h*-indices than younger researchers.

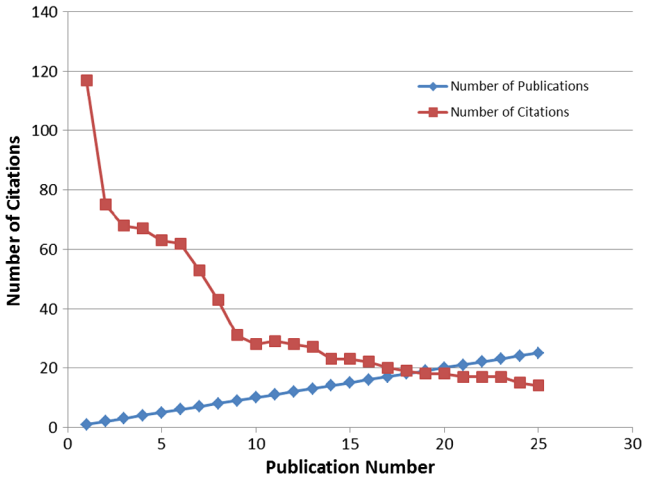

Fig. 1 Driggers citations per publication from highest cited publication to lower cited publications. The *h*-index is determined at the point of intersection of the two curves.

Why did I go through the *h*-index with you? Google Scholar has developed a new journal metric called the h5-index that is very similar to a researcher's *h*-index but is applied to a journal as a whole. It is the *h*-index for all articles published in the journal in the last five years. Google Scholar defines the h5-index as follows:

> The *h*-index of a publication is the largest number *h* such that at least *h* articles in that publication were cited at least *h* times each. For example, a publication with five articles cited by, respectively, 17, 9, 6, 3, and 2, has the *h*-index of 3.
>
> Scholar Metrics currently cover articles published between 2007 and 2011, both inclusive. The metrics are based on citations from all articles that were indexed in Google Scholar as of November 15th, 2012. This also includes citations from articles that are not themselves covered by Scholar Metrics.

Thus, for 2012 a journal's h5-index is the largest number *h* such that *h* articles published in 2007–2011 have at least *h* citations each. It is very similar to the *h*-index for researchers, but the citations are only counted for the past five years. As you can imagine, journals that publish a good number of papers are likely to have a higher h5-index, as are journals that have high citation numbers. Finally, the h5-median for a publication is the median number of citations for the articles that make up its h5-core list of papers.

Optical Engineering has a current impact factor (for 2011) of 0.959 and the h5-index is 28; that is, 28 OE papers published from 2007–2011 have been cited at least 28 times by publications covered in Google Scholar. The h5-median for these 28 papers is 36. Given the number of papers published relative to other journals in the field and the journal's emphasis on engineering, I am reasonably pleased with this number. OE's impact factor has improved over the past few years, but I am a little concerned about next year since in 2011 we had a 45% increase in papers published over 2010. This increase in paper count could increase the h5-index assuming that the average paper quality is maintained. The 2013 impact factor should also increase, since our acceptance rate decreased significantly in 2012, and our paper count increased by 16% over 2011. In both cases, the h5-index should improve with increased paper quality and a larger number of published papers.

At *Optical Engineering*, we will continue to monitor these journal metrics, and we are committed to improving the quality of the journal. We will continue to improve the journal such that it serves our optical engineering and optical sciences constituencies in the best possible manner. Finally, I want to make sure our junior scientists and engineers pay attention to their *h*-index. The short pep talk is to continue to publish papers each year and, if possible, publish papers that are likely to be downloaded, read, and cited.

Ronald G. Driggers
Editor