

ACOUSTICS, THE INTERNET, AND YOU

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Introduction

In 2006, *Time* magazine made a surprising pick for their annual person of the year award: You.¹ The choice of “You” was a symbol of the aggregate contributions to the information age made by millions of individuals using the internet. This online community of collaborators has developed on a scale that has never before existed, effectively transforming the web into a tool for collecting and sharing small amounts of information from millions of people around the world.

So what does this mean for acoustics outreach? While there are already acoustics-related websites and online applications in place, we feel that many aspects of technology and the internet have not been used by the acoustics community to their full potential. The acoustics community could make better use of technology and the internet to promote acoustics to the rising “Millennial” generation as well as to provide an expanded experience for Acoustical Society members.

Promoting acoustics to the Millennials is of particular interest to us, since we are members of this generation. Millennials (as they are often called, but sometimes alternately labeled as Generation Y or the Echo Boomers) are best characterized by having a fundamentally different perspective on technology than any previous generation. With birthdates ranging from 1982 to about 2001, most Millennials do not remember a time when there was not a personal computer in their home.²

A recent *Acoustics Today* article by Busch-Vishniac and West calls for attracting more students to acoustics, correctly arguing that our response should be to promote undergraduate acoustics education.³ There is, however, an additional means for outreach and attracting students that we feel must be discussed: the internet. In today’s world, the internet is ubiquitous and its effective use is at the core of the Millennial generation’s way of life. The acoustics community must find ways to build modern outreach strategies based on new technologies so that others are able to actively and passively interact with the world of acoustics. An added benefit of improving online resources and communications for up-and-coming students is that the existing body of acousticians can use and enjoy them as well.

There are many reasons why we feel that a strong Internet presence is valuable. First, the modern day has brought about new avenues of communication through wireless and high-speed internet, cellular technology, and portable computing, giving rise to a culture of hyper-connectivity. Second, there is an expectation for instant access to

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information. When confronted with obstacles that make finding information even a minor inconvenience—fractured resources, wait times, or excessive navigation—many people now abandon otherwise useful resources in favor of more readily (i.e., instantly) available materials. Third, keeping up with the times is extremely important for attracting new students and members. Millennials are starting to enter graduate school and the work force and they expect that relevant academic and professional resources will be modern and up-to-date.² Finally, there are currently many online

resources which are well-established and extremely popular, allowing for easy adoption by our community. Establishing a centralized online acoustics presence that utilizes these resources is the main focus of this article.

Because of the sheer number of online resources available, it is helpful to sort them into broad categories: informational resources, multimedia, and social networking. In the following sections, we will consider each topic in detail and describe how these ideas can work together to promote acoustics. Then the discussion turns to focus on connecting these various web-based resources together to form a unified presence for acoustics online and create a platform for effective outreach.

Informational resources

The amount of information available on the internet has exploded in the last decade. Increasingly, this information is being made available in non-traditional formats, such as wikis, e-books, and online courses/tutorials. The rise in popularity of electronic informational resources is due largely to the enhanced features inherent in electronic media such as searchability and hyperlinks. Features like these enable “power browsing” and “horizontal information seeking,” behaviors in which the user harvests information quickly by skimming materials on multiple sources in a rapid, disjointed manner.⁴ Web users have come to expect features like hyperlinks and browser tabs to allow them to gather information efficiently. Web-based resources play a vital role in the lives of Millennials and are the de-facto means for obtaining information, including basic and advanced math and science. In this section, we discuss three web-based resources that host information on acoustics: Wikipedia, e-books, and academic journals.

Currently, the largest and best known web-based reference is Wikipedia. Wikipedia is a free, web-based, collaborative, multilingual encyclopedia project supported by the non-profit Wikimedia Foundation.⁵ At present; it has over 16 mil-

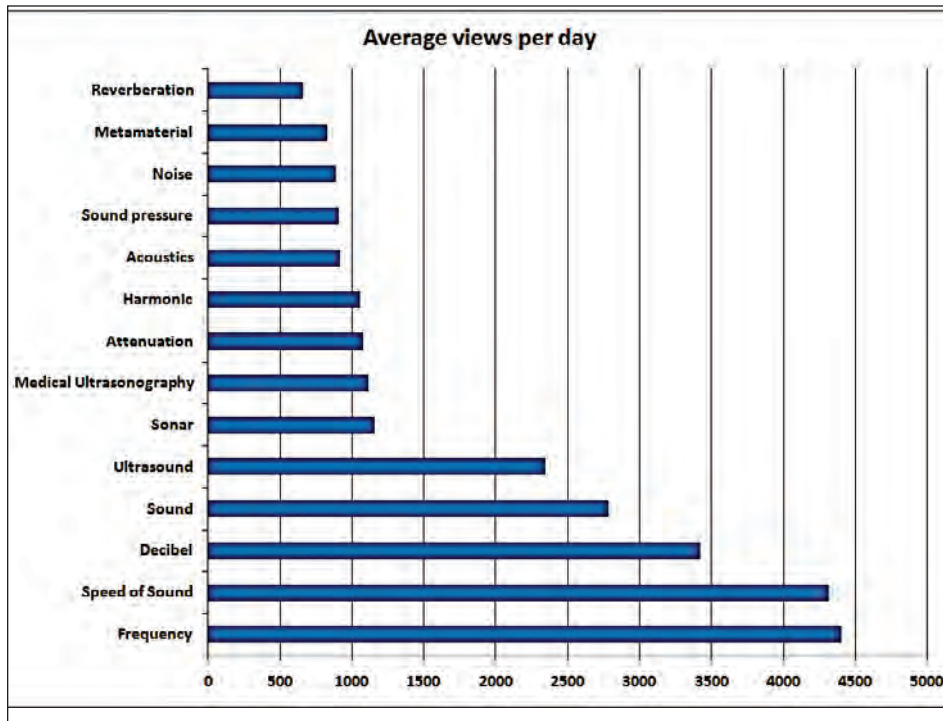


Fig. 1. Average number of page views for acoustics-related Wikipedia articles. The 15 topics shown here are the articles with the highest numbers of views.⁸

lion articles, which range in scope from popular culture to mathematical theorems and everything in between. At the core of Wikipedia is the unconventional idea that anyone can edit the encyclopedia, thus using the common consensus of its active users to establish the expertise on subject. Although questions of reliability and credibility of a topic may arise from time to time, many technical articles are surprisingly accurate, complete, and well-maintained. Central to this method of operation is the concept of “crowdsourcing,” the idea that significant results can be achieved by a large number of people contributing small amounts of work. Consequently, the site has achieved phenomenal success and popularity; current statistics show the site is visited approximately 790 million times per day—more than 9,000 page views a second.⁶ It would be very beneficial for the Acoustical Society to adopt this crowdsourcing approach to maintaining online acoustical resources.

It is disconcerting, however, that a fairly significant number of key acoustics-related articles on Wikipedia are fragmented and incomplete. Many subtopics within acoustics do not have articles, or have articles which are very limited and poorly organized. To understand the lack of clear information, one must merely read the main Wikipedia article on acoustics. There are many glaring omissions: missing technical areas, almost no mathematical formalism, and no mention of fundamental topics such as radiation, reflection, or impedance. Contrast this to the articles on optics and magnetism, where there are introductory equations and fundamental ideas as well as figures and images to outline more advanced topics. By not contributing to the acoustics Wikipedia page, the acoustics community misses a significant opportunity—the article receives an average of 900 views per day! A more complete and accurate description of acoustics will be easily achieved if indi-

viduals contribute simply a paragraph or two to articles that are within their areas of expertise.⁷ (See Fig. 1.)

Alongside Wikipedia, another popular means for distributing information electronically is the e-book. In most respects, e-books are the same as traditional books, except that no printed materials are involved—the buyer instead receives an electronic file with the contents of the book. E-books are attractive to buyers because they are easy to find, very portable (thousands of e-books may be stored on one book-sized device), and instantly available. From an author’s perspective, they’re advantageous since copies are not limited and distribution can be immediate and worldwide. In recent years, the release of standalone e-reader devices such as the Kindle, iPad, and Nook have further propelled this format into the cultural spotlight.

E-books seem well-suited to the acoustics community since it is essentially a modern update on a very traditional means of communication. We enthusiastically note that several books on acoustics have already been made available to purchase in electronic formats from the Acoustical Society of America website. Given the many excellent books on acoustics, we hope that more authors will consider making their works available for purchase as e-books both through the Society and in high-visibility venues, such as major e-book stores. Most importantly, the real benefit of e-books is that they will make it easier for students to find reliable, complete information about acoustics on the internet.

Several classic acoustics works that are no longer under copyright have been made available as e-books free of charge through The Internet Archive⁹ and Google Books.¹⁰ These websites host free e-book versions of Lord Rayleigh’s *Theory of Sound*, Wallace Clement Sabine’s *Collected Papers on Acoustics*, and Harry Olson’s *Dynamical Analogies*, among others. These are great resources, but are not well known or easy to find. Connecting and listing these scattered resources together on a central website will be discussed in detail in the latter part of this article.

An interesting cross between Wikipedia and regular e-books is the open-source textbook—a crowdsourced approach to creating more formal, pedagogical documents that can be edited by anyone and are distributed free of charge. We are aware of two such active projects, one on the *Fundamentals of Acoustics*¹¹ and another on *Engineering Acoustics*,¹² which are currently at varying degrees of completeness. Again, these are opportunities for every acoustician to contribute to a project that will make acoustics accessible to interested students.

Our last major topic in online informational resource for

acoustics is the content from academic journals. Frankly, in this regard it is exciting to see many excellent and well-executed resources already established. A great example of this is the Society's Digital Library. Although the collection is not completely free (articles in *ARLO*, *JASA Express Letters*, *POMA*, and all meeting abstracts from 1929 to the present are open access) nor is it generally aimed toward the novice, electronic versions of journal articles make refereed information on acoustics accessible from anywhere in the world with relative ease.

Multimedia resources

Multimedia provides a unique way of sharing information that is difficult or impossible to reproduce using printed materials and it is particularly useful in the realm of teaching and educating. Historically, most multimedia has been locked into proprietary formats on physical media that have required specialized equipment for playback. For many years, this limited the distribution of materials. Now, however, many types of multimedia to be played back on a home computer and multimedia content can be directly shared via the internet.

The exponential growth of internet multimedia resources in recent years has been largely due to the advancement of commercial-grade graphics capabilities and digital media coupled with the ability and demand for large commercial servers to host content. Media sharing—particularly video sharing—is now a popular means of communication. Other types of sharing, such as podcasting, video conferencing and webinars (web-based seminars), are also commonplace.

We believe that there is great potential for multimedia to be used to promote acoustics education to the rising generation—animations can provide physical interpretation of an equation, audio content can allow acoustics to be actually heard, and video clips can capture scientific demonstrations and real-life applications. It makes sense that the field of acoustics, by definition, would be a discipline that pushes the limits on multimedia in publications. The Society has long enabled multimedia in its publications including *ARLO* and more recently in *JASA Express Letters* and *Acoustics Today's* use of AIP's advanced multimedia server. This development allows for certain creative research to be published in ways

never before possible and illustrates the importance the society gives to multimedia and forging new ground in research. However, in 2009 only 8 out of 73 published Express Letters contained multimedia files. It would be exciting to see our community utilize this functionality better in the future.

There are many forums available for distributing acoustics multimedia online. Many individuals use their personal or work websites to host acoustics content. Dan Russell's Acoustics and Vibrations Animations page is one of the more visible sites since it has won several science awards and boasts over 1.7 million visitors since 2001¹². Likewise, media can also be shared via dedicated services, many of which may be used for free. Videos of lectures and/or teaching demonstrations can be shared on YouTube and iTunesU, audio content may be hosted through services like SoundCloud and Archive.org, and sites like Flickr and Picassa host images.

An additional path forward for promoting acoustics education could be to participate in the open course movement. Universities across the world have been making available audio and video recordings of their lectures and other course materials. The Massachusetts Institute of Technology has been at the forefront of this movement and estimate their courses have been viewed by 50 million individuals,¹⁴ with mathematics and physics courses being the most popular. However, there are only a very few open acoustics courses available. Archiving introductory-level courses in acoustics would be a great outreach method, particularly allowing non-traditional, underserved, and disabled students to learn about the field of acoustics. The content could also be uploaded to the OpenCourse Consortium, which serves as a central depository website for open course materials.¹⁵

Social networking

Perhaps the most astonishing revolution in communication to emerge in recent years is the advent of online social networks. Social networks generally operate by a user connecting to other users based on some form of commonality. On Facebook, one of the most popular social networks with over 500 million active users,¹⁶ members create profiles and add other users as "friends." Social networks are also widely used in the professional and academic worlds for job networking and collaborative work (e.g., LinkedIn and





Study finds honeybees are better able to learn in the morning. <http://bit.ly/aHVQRq>

Aug via Seismic Favorite Retweet Reply

Fig. 2. Twitter post showing an example of a summary and a shortened link to a web article.

Community of Science). In addition, social network users can form, join, and interact in common-interest groups. There are already several groups on these sites for connecting people interested in acoustics; we are aware of groups of acousticians that have created interest groups on Facebook and LinkedIn.

Having members of the acoustics community align their online identities with groups like these is a great first start. However, the acoustics community can use the social networks for more than simply maintaining a badge of affiliation—it could also harness the capability of these networks as a means of distributing acoustics content. Members of the millennial generation may feel underserved by a monthly newsletter, which often appears to them as slow and already outdated by the time it is published. Instead, the acoustics community may be better served by instantly disseminating acoustics content amongst its membership, taking advantage of the built-in ability of social networks to broadcast information. For example, if a web link to an acoustics news item such as might appear in the *ECHOES* newsletter were posted on a Acoustical Society of America Group Page on a social network, the information would be delivered to members of the group. Distribution is automatic, nearly effortless, worldwide, and very effective.

Perhaps an even more radical departure from traditional communications comes in the form of the increasingly popular social micro-blogging services. Twitter is a high-profile example—it allows members to send out messages of 140 characters or less to a group of other users that have elected to receive the sender's messages. Because of the space limitation, more in-depth content is usually distributed with a brief headline followed by a shortened link to an external website. An example of such a message is shown in Fig. 2. The potential also exists for using micro-blogging services to spread relevant content to the acoustics community. For example, Twitter feeds could be used to distribute the "Acoustics in the News" section from the *ECHOES* newsletter; already the Society's Student Council uses a Twitter account (@ASAStudents) to quickly spread the word about student events at society meetings.

It certainly would benefit the acoustics community to have the tools in place to harness social networks, thereby exposing its members to the latest events in the field and increasing the visibility of acoustics in general. However, for the success of such a social networking presence, content must be supplied by an apparent authority on the subject, such as the Society, or the feed may not be considered reputable.

Dedicated acoustics sites

Up to this point, we have addressed online opportunities without fully discussing the need for infrastructure. As has been mentioned several times already, we feel there is a critical need for the establishment of strong, dedicated resources to unify and anchor the online acoustics community. There are two major sites sponsored by the ASA that act as hubs for the acoustics community: asa.aip.org and acoustics.org. Since these appear among the top 5 results under "acoustics" in most search engines, there is significant potential to use these websites to expose new Internet users to acoustics. The Society's Home Page is the central hub for all things related to the Acoustical Society of America. We understand that major revisions of the asa.aip.org site are currently underway to upgrade the look and functionality of this site and it will be released very soon.

The acoustics.org site is another valuable hub for the general acoustics community. It houses information on acoustical news, textbooks, upcoming events, academic programs, demonstrations, employment, and a number of other great resources. It has the potential to be an excellent reference and outreach page. However, there are several aspects of the page that must be improved to maintain its effectiveness. The design is outdated, giving the impression of a neglected page. There are also far too many broken links and dated sections. Subpages should be expanded and modernized to include links to related wikis, shared multimedia, online maps and professional networks. The acoustics.org site should carry the reputation of the Acoustical Society so that their members feel comfortable that materials retrieved there are trustworthy and of excellent quality.

In short, we believe that it vitally important to health of the Society that these pages not only be updated and modernized but maintained on a continual basis. Unlike other efforts outlined in this article, the changes we advocate for these central sites are not likely to be successfully realized without official and significant effort by the Society; we anticipate these initiatives will require the full-time support of one or more individuals. Once established, these resources can connect to the existing informational resources, multimedia, and social networking discussed in previous sections to provide a comprehensive online resource for acoustics which we feel will be much more successful in promoting the Society and attracting new members.

Conclusion

Our vision is to see a renewed student interest in acoustics. The Millennial generation, having embraced a culture of internet-enabled connectivity, likely includes prime candidates for the acoustics community. With the new communications technologies that this generation has embraced comes multiple opportunities that we must recognize and use to our advantage. Ignoring these resources will limit the ability of the acoustics community to connect and outreach, both now and in the future.

We feel the most crucial item on the agenda is to create and update central hubs for acoustics on the Internet. These would serve as go-to resources for anyone interested in

acoustics. No less important, the next step would be to connect to the many preexisting resources we have discussed: key informational sites, multimedia providers, and social networks. Finally, we note that, for the most part, this agenda of adapting to Millennial-era technology should not be a vast undertaking by the Society or some other single entity. By the very nature of these new technologies, effective change is likely to be the result of many small contributions by individuals. The next step forward to make acoustics outreach better must be made by You.^{AT}

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Scott Porter is pursuing a Ph.D. through Penn State's Graduate Program in Acoustics and his research focuses on investigating iron-gallium alloys for application in magnetostrictive sonar transducers. He has an M. Eng in acoustics from Penn State and B.S. degrees in physics and engineering from Kettering University. Scott is

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