
New Media



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Free software and an almost-free bioacoustics research instrument

This month I would like to introduce the anesthesia community, particularly the “computer geeks” among us, to a particularly interesting technology known as real-time spectral analysis. Until now, this technology was used mainly by telephone and recording companies, but I expect that with some relatively simple experimentation this technology will also prove to be quite useful for studying bioacoustical emissions during general anesthesia and even during routine patient screening. Consequently, I would like to encourage the evaluation of this interesting new scientific method by anesthesiologists who own laptop computers. (Desktops computers have to be plugged in to mains power, raising a potential safety issue when one is connected to a patient; an obvious and easy solution is to always use a laptop computer running on batteries. Also, a laptop will fit on a Mayo stand while a desktop on a cart usually takes up a lot of room in the operating room and can complicate moving around.)

Note that besides heart and lung sounds, bioacoustics also includes the study of bowel sounds, knee sounds, laryngeal sounds, phonations, vascular sounds like carotid and femoral bruits, and even sounds emitted from the ear itself (detectable by placing miniature microphones in the ear canal). Did you know that the acoustic emissions (bruits) from intracranial arteriovenous malformations or aneurysms can sometimes be detected with a microphone placed in contact with the skull? As you can see, this is an area of potential research that is fascinating but largely unexplored. Probably more research has gone into exploring whale sound spectra than bowel sound spectra, a curious state of

affairs considering the number of patients who spend extra days in hospital awaiting the return of bowel sounds after abdominal surgery. (Experiment to consider: will cautious neostigmine administration accelerate the development of bowel sounds in patients recovering from ileus?).

Of considerable interest to many is the lack of expense involved in constructing a research instrument for the study of bioacoustical emissions: one can convert an ordinary computer with a microphone jack into an advanced acoustical research instrument merely by adding a microphone and downloading a free software package from the Internet. To many, this arrangement compares rather favourably with commercial systems usually costing in the range of \$10K and above. The software, known as Spectrogram version 5.1, “is a free-ware dual channel audio spectrum analyzer for Windows 95/98/NT which can provide either a scrolling time-frequency display or a spectrum analyzer scope display in real time for any sound source connected to your sound card.” This means that one can quite inexpensively acquire an instrument for real-time spectral analysis of bioacoustical emissions such as heart sounds, breath sounds or the acoustic signals found in the anesthetic circuit. For instance, in experiments with breathing circuit sound recordings, I have obtained interesting results by placing miniature microphones into the patient breathing circuit at one of three places: (1) near the expiratory valve, (2) near the inspiratory valve, and (3) near the endotracheal tube. For a look at a sample of this technique applied to a phonocardiogram (heart sound) signal I recorded from one of my (healthy) students, take a look at www.canmed.net/spectrum.jpg I encourage those computer owners

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who wish to evaluate the potential role of this technology to read more about audio spectral analysis and download the free software at <http://www.monumental.com/rshorne/gram.html>.

Another piece of excellent spectral analysis software, and much simpler in use and operation (but of course less powerful than the above program) is the program `freq.exe` available for free from Reliable Software (www.relisoft.com), a small, intellectually elitist software company run from Seattle, Washington, USA by a Polish-American physics PhD. The company prides itself in producing complex software with unusually high-reliability (hence the company name) and offers as evidence of their unusual skills this well-crafted program in both directly usable (binary) form and in source code form. (By making the software available in source form, the program can be understood, critiqued, and revised. However, programs in source code form cannot be run until they are converted into binary form by a piece of software known as a "compiler"). Jobs at Microsoft's sometimes less than professional programming practices are also made at the company site, and are backed up with specific examples in technical detail (the president worked at Microsoft for many years). Also included at their site is a series of essays on the construction of reliable software, material that will eventually become a textbook. And all of this is free. Few companies disclose their source code and program documentation, but Reliable Software, in a fine example of "intellectual philanthropy", has made a nice little contribution to the scientific community by making this software available so easily.

Another program that can be useful in studying bioacoustical signals is from a small Newfoundland company and is called Goldwave. Goldwave is perfect for editing audio signals, and using this well-designed but complex program one can cut, join and filter signals with ease as well as carry out a number of special effects less likely to be useful in bioacoustics. The program will also compute power spectra. The program can be downloaded at www.goldwave.com but it is not free. Rather, you are given a period of time to play with the program, after which the author expects that you will pay up. This is called shareware. Sometimes shareware is crippled by making useful features unavailable until one pays and registers. This is sometimes called crippleware. Since Goldwave is offered uncrippled, it likely means that the author trusts that he will be paid (not the case for most shareware) or has a philanthropic bent. This site is also an excellent example of Canadian software e-commerce.

For people with money to spend, even more sophisticated systems are available. MATLAB ([\[works.com\]\(http://www.mathworks.com\)\) and LABVIEW \(\[www.natinst.com\]\(http://www.natinst.com\)\) are two popular and especially powerful scientific computing environments that run on a wide variety of computing platforms. Both these platforms can use either the sound card on your own PC or a special multichannel data acquisition card. Both programs support spectral analysis in many variations.](http://www.math-</p>
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Electronic graffiti

Recently someone electronically defaced my discussion page on the laryngeal mask airway by entering a sexually offensive posting that I was unable to delete completely (not being particularly talented at hacking Microsoft Front Page, the Web authoring software I usually use). The defaced page may be viewed at <http://canmed.net/lma/> This form of electronic crime is tough to fight even when using a human moderator who is willing to sort through the messages received. For an example of a high-quality, moderated web site for discussions and postings on technology risks, visit <http://catless.ncl.ac.uk/Risks> For an example of an unmoderated but quite civilized discussion site take a look at GASNet's Discussion Forum running on their anesthesiology server (<http://gasnet.med.yale.edu>). For an example of a web site that has become corrupted and damaged by insults and flames I would suggest any number of discussion sites devoted to scientology, gun control, abortion or any other controversial issue.

Free textbook of emergency medicine

<http://www.emedicine.com/emerg/index.shtml>
This project offers well-written discussions on 688 topics related to emergency medicine. The peer-review process is extensive, making this site especially valuable for medical students and residents. The textbook, supported by grants and advertising, is easily updated even monthly, very unlike conventional paper textbooks that are revised at three to five year intervals. As sites like this become popular it will eventually be possible to rely completely on free Internet materials for all stages of medical education. Such a development has important implications for the medical publishing industry. (Remember the slide rule?). Similarly, the new American NIH initiative in electronic medical publishing will create two strata of research information available free via the Internet: classical peer-reviewed articles as we know them now, with editorial boards and a thorough review process, and a second kind of resource, consisting of material not yet reviewed but nonetheless useful to many in a specific technical field. Examples of the latter might include copies of manuscripts awaiting peer review publication or awaiting revision or even not

especially original electronic circuit diagrams that some scientist once found to be useful. The service will be called PubMed Central and will serve as an NIH-operated site for electronic distribution of life sciences research reports. For more information visit <http://www.nih.gov/news/pr/aug99/od-30.htm>.

Free merck manual
(<http://www.merck.com>)

Another nice example of information philanthropy comes from Merck and Co. Inc., who have made available free for unrestricted reading three important medical books. The first is the Merck Manual, published for 100 yr on a not-for-profit basis. This book has become the world's most widely used general medical text and is now published in 14 languages. Merck also provides free web versions of the entire 2nd edition of The Merck Manual of Geriatrics and part of The Merck Manual of Medical Information—Home Edition.

Book recommendation

Simon Singh. The Code Book. The Evolution of Secrecy from Mary Queen of Scots to Quantum Cryptography . Doubleday 1999, ISBN 0-385-49531-3. A fascinating history of cryptography and data encryption with enthralling accounts of its military and diplomatic importance. The more technical aspects of cryptography are safely relegated to appendices.