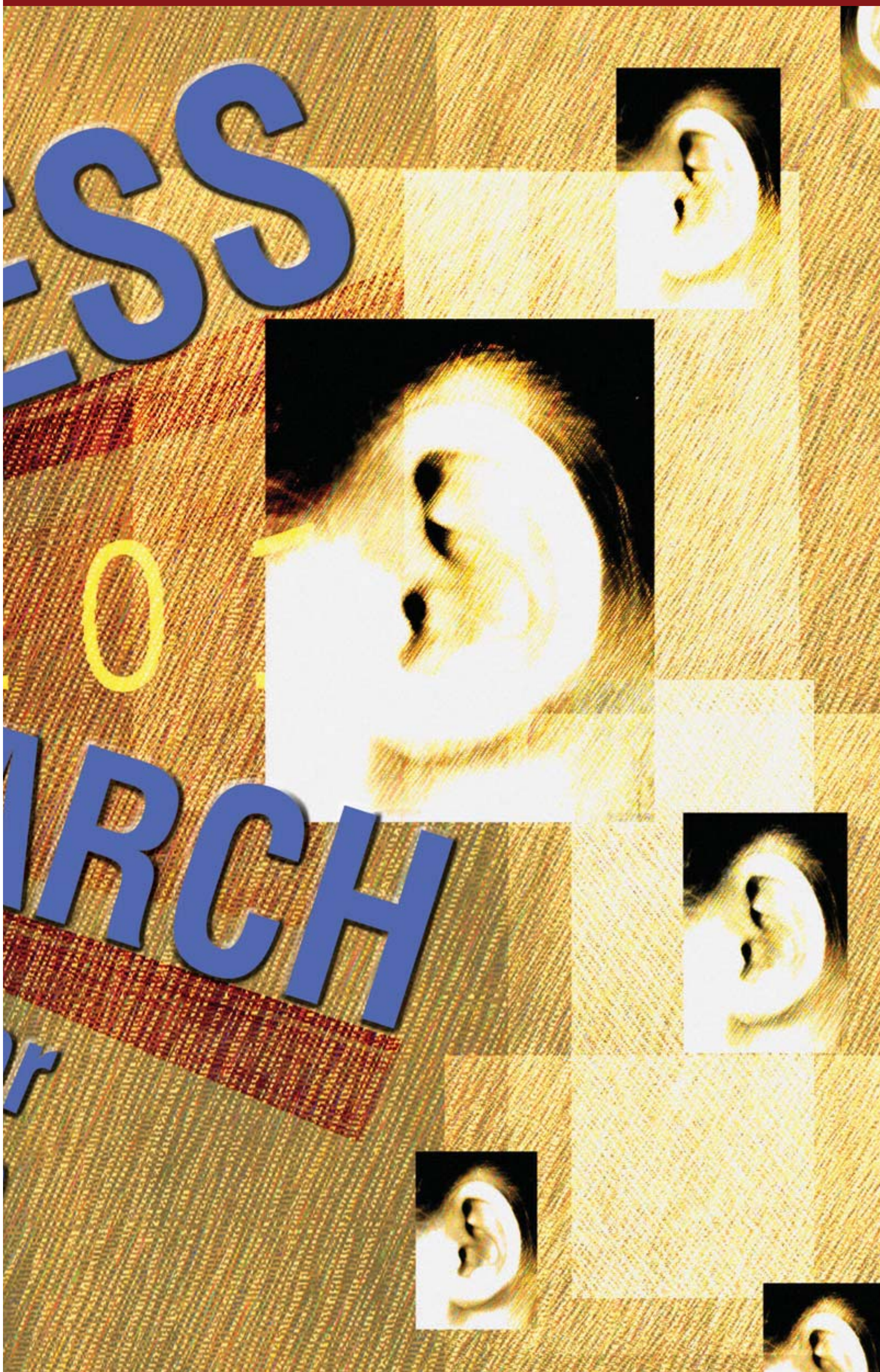

LOUDNE
RESEA
into a majo
health issue



BY DAPHNE LAVERS

On a scale of global geopolitics or international warfare, it doesn't seem to be a show-stopper of a problem.

You're watching the 6:30 dinnertime news. At 7 p.m. you change channels to BBC World News and the voice of the BBC news host suddenly booms across your living room, much louder than the local news you were just watching. You quickly reach for the remote and turn the volume down a notch or two.

You're watching a late-night movie—*On Golden Pond*, perhaps. The scene fades to black, and the yellow-check-suited pitchman for the local furniture mall suddenly shouts across the room, *"MIDNIGHT MADNESS ENDS TONIGHT—DON'T MISS THIS ONCE IN A LIFETIME SALE!"* The cat leaps straight off the couch, all four sets of claws raking the leather, down the hall a light switches on and your spouse calls sleepily, "Everything okay out there?"

You're driving down the highway. On the radio, a rock ballad fades into silence, and that same yellow-check suited pitchman—you recognize the voice—yells the same *MIDNIGHT MADNESS SALE* message. You grope for the volume knob on the dashboard, and try not to change lanes at the same time.

Variable volume levels between channels and within programs one might think is, at this point in world history, a nuisance, sometimes minor, sometimes more than minor. Viewers and listeners reach for the remote control or the volume knob, and simply turn down the volume.

If you're a broadcaster, you may receive a phone call or two, or perhaps a letter, from listeners who want you to do something about this.

If you're a cable or satellite operator, your switchboard may periodically light up with viewers irate about the volume jumps on their service.

If you're a movie theatre operator, you may have parents yelling at your staff after the movie ends, about the volume level of the movie or, more frequently, the volume level of the trailers—those pre-movie advertisements for movies "coming soon".

If you're an advertising agency or production house, you may know perfectly well that you've cranked up the volume three to 10 decibels on some of the ads you supply to both broadcasters and movie theatres. You know nobody's going to fine you.

But the curious gaze of scientists changes focus from time to time; as one problem is resolved, another piques the interest of those inquisitive minds who forever ask, "How does this work?" and "Why does it work this way?"

Over the last few years that curious gaze has landed on the issue of loudness; to be more specific, the measurement of loudness in radio, in television and in film. Because at the end of the day, how do you know if something is too loud, if you don't know how loud is "loud"?

Measuring "Loud" in Analog and Digital TV

Measuring "loud" as well as "too loud" has caught the attention of broadcasters, scientists and audio researchers around the world, from the ITU (International Telecommunications Union) to the EBU (European Broadcasting Union), from the ABA (Australian Broadcasting Authority) to our own CBC.

In analog days, if an audio signal at a television station seemed too loud, a technician on duty could simply turn down the volume. It was easy; audio signals were separate from video signals. The sensibility of the technician on duty was usually enough to keep everything in line.

The move to digital has complicated things considerably. As broadcast plants have turned to managing television signals as data, broadcasters use internal network systems to move the broadcast signal around the television station and out into the world. Readers may be familiar with the phrase "270 Meg SDI transport stream"—that's a 270 megabit-per-second digital video transport stream—the size and speed of digital signals often on a television station network which could be carrying programs, commercials, news, sports and everything else needed by the operation.

Adoption of new television standards for high definition television eventually settled on a possible 18 video formats acceptable to the U.S. Advanced Television Systems Committee (ATSC). But as far back as 1993, ATSC recognized varying audio levels, even in the new HDTV formats, as a potential problem.

In digital technology, the audio signal is embedded in the digital bit stream, as is the video signal. Bits are bits and data is data; it's all one data stream. Everything moves together. So as programs, advertisements and other program material come into a broadcast plant, the audio levels on each bit of material can be wildly different.

"When it's embedded you can't control the audio level anymore," said Anthony Caruso, director of new broadcast technologies for CBC. "In order to control the audio, you have to de-embed, adjust the level and then re-embed again. That's very expensive. To de-embed, you're looking at a $110,000 decoder, to re-embed, $50,000 to buy an encoder. It's very expensive and also it degrades the quality of the signal. That was the problem, because you embed the audio with the video."

Slightly Different for Cable and Satellite

At a cable or satellite master control, television channel signals are arriving from across the country and around the world.

"The CCTA was approached by some of the cable companies saying we're getting a considerable number of complaints and it was the two types (of complaints), between-channel and advertising that just booms," said Michelle Beck, vice-president of engineering for the Canadian Cable Television Association (CCTA). "For cable operators, it's quite easily done to do that comparison (of audio levels between signals) and realize that there are huge discrepancies in the loudness of signals that are side by side, or between the advertising and main program."

The audio levels can differ substantially between all those channels. In addition, while some of those channels are still analog, many are now digital—and both are carried on the same network system.

Changing the audio level might be necessary for just part of a single program or for an entire channel. The equipment to measure loudness, to decode and re-embed audio is not only expensive, it's also not that readily available at present. Even if such equipment is available, how can a determination be made as to what is "too loud"?

You need an audio level meter. How do you build an audio level meter that matches what humans hear?

You need human listeners to set those parameters. How do you take human audio perception and use that as the scientific basis for measuring loudness?

You call the Advanced Audio Systems division at the Communications Research Centre (CRC) in Ottawa.

ITU, CRC, Objective & Subjective

The International Telecommunications Union (ITU) did just that.

The ITU is an agency of the United Nations charged with co-ordinating the use of the radio spectrum world-wide. It is an international standards organization that develops technical and scientific guidelines and parameters, particularly for technologies that cross borders. ITU-T is the organization's telecommunications division. ITU-R is the radiocommunications division. Within each division are subject-specific working groups including SRG3, the Special Rapporteur Group 3 that is working on the problem of audio levels.

The ITU-R's SRG3 contacted Dr. Gilbert Soulodre, project leader in the CRC's Advanced Audio Systems group and a psycho-acoustics expert. Soulodre is also an expert in subjective testing, an essential pre-requisite for objective testing.

"Subjective" refers to "proceeding from or belonging to the individual consciousness or perception" (Oxford)—in this case, human testing of loudness levels in which individual test subjects listen to audio clips and determine what, to each of them, is loud and exactly how loud.

"Objective" refers to things "external to the mind—dealing with outward things or exhibiting facts uncoloured by feelings or opinions" (Oxford)—in this case, actual existing loudness meters and how well or poorly they can gauge loudness.

The first step in this experimental

program was to develop a database of subjective perceptions of loudness—in other words, what are the audio levels that human listeners find "loud" or "too loud".

Being a scientist, Soulodre naturally employed the standard accepted scientific method of experimentation together with the psychological testing necessity of a "double-blind" study. In classic double-blind studies—essential to ensure that the presence or knowledge of the experimenter does not affect the outcomes—even the scientist doing the experiments does not know which test subject is which. Soulodre set up subjective experiments with 97 human listeners in five laboratories around the world listening to 96 mono audio sequences.

The Experimental Set-Up

"A three-member panel of SRG3 members selected the test sequences as well as the reference item. The sequences were taken from actual television and radio broadcasts, and were chosen to provide a broad range of program material from around the world… The test sequences can be roughly classified into eight different categories according to their content …speech only, no background sounds; drama, dialogue with environmental sounds; speech with background music; speech with background sounds; instrumental music; music with a lead singer; singing voice with no instruments; sound effects—environmental sounds, no speech," Soulodre wrote in a scientific research paper, *Evaluation of Objective Loudness Meters*. The paper was submitted to the 116th convention of the Audio Engineering Society (which awarded Soulodre a Fellowship for his research) held in May of this year in Berlin.

The tests were conducted at five different test sites including the Australian Broadcasting Corporation (ABC), the British Broadcasting Corporation (BBC), CRC in Ottawa, the National Acoustic Laboratories in Australia and the National Film Board (NFB) in Montreal. Using five test sites ensured that the testing couldn't be considered biassed by being done at only a single laboratory.

Michael Drolet is a consultant in the technology development division of the National Film Board in Montreal who worked with a representative from Dolby Laboratories to select sound clips for the test. Drolet also ran Soulodre's loudness experiments conducted at NFB.

"There was a wide variety of sound clips from different broadcasters around the world, so there wasn't a regional bias in the source of sound—some were Japanese, some Hindi, there were some Australian and German," he said. "We went through several dozen sound clips from around the world; a lot of them were longer than a few seconds. Most test clips were 10 to 15 seconds long and we selected them from much longer clips, much longer samples provided by the different broadcasters.

"We had to select a section that could be looped easily so that the apparent loudness at the end of the clip matched the (loudness at) the beginning of the clip as well, so that it wouldn't skew the testing—in other words it didn't get louder or softer as the test went on. That was quite interesting, picking that out; and some of the clips were in foreign languages that I don't understand, other than French and English for instance, so we had no idea what we were listening to, which I guess makes a really good blind test."

Experimenting—The Objectives

The test subjects were provided with

a "reference signal"—an audio clip of predetermined loudness, and access to the 96 audio test sequences.

"The task for the subject was to play with the volume until the test sequence had the same loudness as the reference sequence," said Dr. Soulodre. "Because this was all done on computer, we could record how much they had offset the level —what the adjustment was on the volume control. So for each subject, for each test sequence, we had how much they felt they had to adjust the volume."

This adjustment was the difference between the reference sequence and the test sequences, as judged by the human test listeners. "We had this difference measurement in decibels for each of these test sequences—that forms our subjective database."

For the objective part of the experiment, the first task was, at heart, scientific housekeeping—comparison of the results between all five laboratories where the tests were conducted to determine initially that all five labs were basically doing the same experiment in the same way.

"We had .99 correlation between the labs," said Dr. Soulodre. "Everybody was following the instructions in very much the same way. You really run the risk of people misinterpreting some instructions. Inevitably the set-ups are going to be different, what speakers are they using, what kind of room are they in, there could also be cultural differences—but because we had such high agreement, everyone was doing the same test and whatever differences there were weren't important. That was quite reassuring."

Not to mention, remarkable.

Then 10 actual loudness meters were sent to the Communications Research Lab in Ottawa, manufactured by seven different private companies such as NHK/Hamaki, Opticom, Dolby Laboratories, Dorrough and Pinguin. Each meter was tested to ensure that it was operating as intended, and that its operations were understood.

This is where the "double-blind" element of scientific experiments entered the picture. At this point, the identity of each of the meters was obscured so that experimenters could not tell which meter was being evaluated at any particular point in the experiment. This ensured that the experimenters can't be accused of having "weighted" the results for or against any particular meter about which they might have opinions.

Each of the meters was subjected to the same audio sequences used by the test subjects. The object of this exercise was to see which meter best approached the human assessment of loudness for each of the test sequences.

"In other words, what we want to do is find a loudness meter that can replace what the subjects have done in this loudness matching experiment," said Dr. Soulodre.

And what were the results?

This is where it gets interesting, and where the rigours of scientific enquiry really come into play.

And the Results Are…!

The results of Dr. Soulodre's experiments were presented in August, 2003, at a meeting of the ITU-R Special Rapporteurs' Group at CBC headquarters in Montreal. That group is chaired by Craig Todd, senior member of the technical staff at Dolby Laboratories.

"Four or five years ago, I got the ITU involved in trying to set a standard in how we would measure the signal (of audio loudness)," said Todd. "You try to do a measurement that corresponds to

Decibels and RMS

For those of us not technically inclined, the precise definition of decibel is complicated, having to do with ratios, logarithms, sound waves and power transmissions.

Suffice to say that ordinary conversation is about 60 decibels (dB) measured at a distance of about three feet. Other decibel measurements for comparison include:

- 3 dB—the smallest change in sound level that most human ears can detect.
- 70 decibels—loudness of a hair dryer, vacuum cleaner or gas-powered lawn mower.
- 80 dB—loud music played at home or heavy street traffic.
- 85 dB—provincial on-the-job noise levels for B.C., Alberta, Saskatchewan, New Brunswick, Nova Scotia, P.E.I. and Newfoundland.
- 90 dB—a truck passing on the street and the provincial on-the-job noise levels for Manitoba, Quebec and Ontario.
- 100 dB—a rock band.
- 120 dB—pain threshold, deafening.
- 120-130 dB—jet aircraft.

What's interesting about decibel measurement is that it is, technically, a ratio measurement; every 10 dB increase in sound levels is actually twice as loud, so 60 dB is actually twice as loud as 50 dB, and 80 dB is twice as loud as 70 dB. That puts a different perspective on loudness.

So when audio measurements calibrate sound levels for movies such as *Lord of the Rings* of 78 dB with peaks of 95 dB, and levels for *Harry Potter* were 74 dB with peaks at 93 dB, audiences are correct when they complain that sound levels are too high. The German measurements of cell phone games at above 133 dB is literally mind-blowing—and ear-destroying.

The simple measure that Dr. Gilbert Soulodre decided to throw into the mix of audio loudness meter is called RMS. While engineers are familiar with this function, for those of us not quite that technically knowledgeable here, hopefully, is a simple explanation.

- RMS is a mathematical function; it is used in science and engineering in a host of analytical applications, not only for audio loudness measures.
- RMS means "root mean square" and is a standard method used by scientists to analyse statistical data—an equation that averages numbers including numbers that are both positive (+) and negative (-).

The equation is:

$$RMS = \sqrt{\frac{(n1^2 + n2^2 + n3^2 + n4^2....)}{N}}$$

N = the number of numbers and

n1, n2, n3 are the numbers to be averaged.

Or more simply;

$$RMS = \sqrt{\frac{\text{sum } (\#s)^2}{\# \text{ of numbers}}}$$

To calculate RMS:

- square each number—that makes all negative numbers positive;
- add them all;
- divide by the total number of numbers;
- take the square root of that final number (since the numbers were squared in the first function).

That provides the average in a positive number. That is the very simple method which Dr. Soulodre discovered predicted loudness as well or better than the private-company loudness meters.

— DL

how we hear, not a simple electrical measure. The hope was that we could get world-wide agreement on one method and that method could be referred to by regulatory bodies, built into products by multiple manufacturers and get everybody using the same measurement system so we could interchange stuff easily."

Dolby Laboratories, one of the preeminent manufacturers of audio equipment, has, understandably, more concerns than simply the irritation of audio loudness or softness.

"As we move to digital delivery, digital signals can go much louder and much quieter, there's much more dynamic range available, and this dynamic range should be available to be used for dramatic effect," said Todd. "If you want to play *Star Wars* (at home) and have it sound like it did in the movie theatre—when it's a quiet scene and the wind is rustling, it should be very quiet, and when the Death Star explodes, it should be really loud, and when people are talking it should be a pleasant level—you'd like to deliver that sound to the home. But it's ripe for abuse because you have the guy selling you soap at the same level as the Death Star exploding and that's really objectionable."

In Montreal, the first day of the two-day meeting of 18-or-so participants was spent determining criteria for gauging the effectiveness of all the meters. While Dr. Soulodre had done all the experiments prior to the meeting, he had not, significantly and deliberately, done the analysis on those results. Only at the end of the first day, when all the participants had decided on all the criteria for success of meter performance did he analyse the data from his experiments in order to present that analysis the next day. This is part of the "double-blind" method of scientific enquiry that eliminates any potential bias on the part of the experimenter.

"In Montreal, there was a winner but it wasn't one of the proponents," said Dr. Soulodre. "I submitted two meters, two incredibly simple meters that were supposed to be sort of benchmarks.

"One of them is just straight RMS (known in audio circles as LEQ—equivalent loudness) that has been in textbooks forever (*see sidebar*). It's a simple measure; in engineering, many many things look at what is the RMS value—the Root Mean Square—of something. I put that in just as a benchmark, and then I put in a slightly modified version that would take a little bit into account how the ear works—the ear is less sensitive to really low frequencies, you don't hear them as loudly as you do others."

On the second day of the meeting, Soulodre presented the results of his analysis of the audio meters submitted for testing.

"While they were going through all this paper, I thought to myself, I wonder how my two simple ones worked now that we've established these criteria," Soulodre said. "So I did a quick analysis on the two simple ones—it was trivial to do at that point. And I looked at the results and I thought, my simple meter is outperforming all the other ones!"

This was one of those memorable, classic and, to some degree, sticky moments in scientific research. A simple testing method thrown into the mix as a benchmark by the principal investigator turns out to perform better than all the other privately-backed devices, systems and methods tested.

"When I went to this Montreal meeting, I already had an inkling that these very simple things (the RMS measures) were performing quite well, so it was to be seen how well the more advanced meters would perform," said Dr. Soulodre. "I knew there were going to be these advanced loudness meters that proponents were developing and putting forward and it was very likely that one of them would be adopted as an international standard. My question for myself and the goal of writing the paper was `are there some very simple measures that will get us most of the way there?' So in anticipation of having a more complex meter that might be computationally demanding and might be associated with some royalty payments (for broadcasters and anyone else who wanted to use it), would there also be some 'cheap and cheerful' measure that would be computationally simple (with) no royalties attached that some people could use in less stringent situations?"

There was such a measure; it was his. What to do?

Surprising Results

Soulodre asked the chairman for a quick break, reviewed with him in private what he had discovered, the meeting reconvened and the minutes of that meeting present a succinct summary of subsequent events.

"Debate about further eliminations (of devices) ended abruptly when Mr. (sic) Soulodre presented results from his generic algorithms showing that an unweighted average RMS power (referred to as LEQ) measurement matched the subjective assessments better, for all of the defined criteria, than any of the more sophisticated methods. This result stunned all the attendees," stated the meeting minutes.

Said Dolby's Todd, the chair of the working group: "That was a real shock to the participants. Really, man-years of effort have gone into trying to make metering algorithms that correspond to the complex way the ear works, using psychoacoustic theories, etc., and to find that how much power is in the signal matched listening tests better than these very sophisticated meters based on the most advanced psycho-acoustics, it was a real shocker!"

It was also rather shocking to Dr. Soulodre. It was indeed a sticky wicket, as the English say, but the fact of the matter was there in black and white.

With understatement characteristic of the scientific community, Dr. Soulodre described what happened next.

"There was some vivid(!) discussion about 'how could this be?'… The immediate reaction was there must be something wrong with the subjective data base," he said. "That's why I had tried to be quite careful about this the day before, saying we've set all the criteria and by the criteria this is the best one. And we've already gone through all the subjective results and we've decided these five labs have done a good job, and the process earlier had agreed on the subjective test method and had also agreed on the subjective test sequences. That's why I had very carefully the day before got everybody's full agreement on accepting what we had for the subjective database… (they) were quite taken aback. I was too, although I did have a hint what might be coming because I had been working on this other paper. I knew it (his own entry) would perform reasonably well, I just didn't know earlier on that it would actually outperform the other measures!"

As the meeting unfolded, a number of decisions resulted such as the requirement for further experimentation, exchange of data, examination of methodology used, and identification of test results of each meter to its proponent. Broadcasters at the meeting were fine with the results; Soulodre's method provided a clear, simple way to test loudness that didn't require much in the way of effort, royalty payments or purchasing power.

A Simple Measure

"It's certainly a very usable method and we would encourage anybody who needs to measure things today, that's probably the best thing to do today," said Todd. "The question is, should that be the system that's adopted and agreed to for world-wide use for the next 50 years or can we do a little better?"

In early 2004, a new set of test sequences—test sequences of a more "diverse" nature—was sent by members of the SRG to the Communications Research Centre. CRC did not do another complete set of experimental trials—at that point, that would have been too time-consuming—but tested these new sequences only at the CRC facilities.

"My goal was to see (if) these simple measures fall apart with this second set of data," said Dr. Soulodre. "The answer is no, it still seems to work quite well."

Some European broadcasters have reportedly been using techniques similar to Soulodre's for some time with considerable success.

The ITU community has decided to work on another set of loudness tests with a wider variety of sound signals. And instead of measuring only single channel monophonic signals as in Dr. Soulodre's experiments, the plan is to measure two-channel stereo and multi-channel, five-channel programs. Dolby 5.1 digital audio is the standard for audio for High Definition Television.

"How loud is a five channel program?" said Dolby's Todd. "As a (test) listener, you give the program one value of loudness, but with the meters we've tested to date we'd have to have five of them, one on every channel and how do you combine the five measurements to produce one measurement that says this program is this loud? That hasn't yet been tested."

HD, Audio Loudness and the International Dimension

In fact, the new television channels may have more than five audio channels, observed Anthony Caruso, director of new broadcast technologies for CBC.

"HDTV is a different animal now," he said. "We are planning to put six (audio) channels on HDTV and most broadcasters want to do the same thing, they want to carry 5.1 Dolby digital audio which is like six channels, two front left and right, rear left and rear right, and then you have the surround, and a low special effects channel which is the sixth channel."

Caruso has also been involved in audio testing—in fact, he's a member of Craig Todd's SRG3 group. He's also involved with the World Broadcast Union (WBU) which has been working on audio level controls originating with their Inter-Satellite Operations Group, known as ISOG.

"In 2001 at a meeting in Washington, (the group) came up with the same problem—when they started to digitize their operations they found they could not control their audio level anymore," said Caruso. "When we exchange news between broadcasters in the Union, say BBC with TV New Zealand, we found that the different levels are very high and there's no way to control it."

CBC Engineering began working on the problem through their membership in NABA, the North American Broadcasters Association, a key member of the WBU, as well as working with ITU-R group.

"We have to find a way to equalize—to make uniform—the level of the embedded audio within the video; that's whole idea, to embed at the level that everybody will use as a kind of reference or alignment level to embed the audio within the video. That would alleviate the problem," said Caruso. He is familiar with the RMS loudness measure, but notes, "this is only for voice—voice and really for news. If you go beyond that it might not give you the right weighting, so that's why we need an algorithm that can be used for all types of sounds, home theatre sound, hi-fi, music, voice, (but) this works very well for voice applications."

Cable Industry Focus

In the cable industry, meetings with broadcasters in 2001–2002 identified the problem and also identified the requirement to preserve "artistic licence" for programmers. If a program or a commercial was created at a certain audio level, cable operators were required to simply pass that signal through. But since it's often the cable company that receives the complaints, the cable industry felt the need to start looking at the problem.

It was also discovered that some audio equipment already in use only required levels to be set in-house, an educational process to which CCTA contributed as did Dolby Laboratories. Last year, for example, Dolby sent out test equipment to Canadian broadcasters to help them measure loudness levels.

"Our idea was, let's not try to force everybody to use the same level, let 'em use whatever they want," said Dolby's Craig Todd. "but require that the broadcast contain some extra data—since this is all digital it's easy to carry, there's a 5-bit value we call DialNorm and it's supposed to indicate how loud the dialogue is with respect to full scale, and every Dolby Digital decoder uses that value of DialNorm and adjusts the volume in the home up and down based on changes in that value. In practice, what's happening is people don't understand it, they don't have the tools to set it, it's not being set, it's just whatever the default value is when they take it out of the box. If our encoder does not receive any value, it still has to put something in the bit stream. So there's an internal setting and that internal (default) setting is in use 80% of the time because nobody has changed it to match the broadcast plant."

CCTA also sent out three information bulletins on setting audio levels including information on, for example, Dolby equipment to help in determining and then setting levels.

"The problem is exacerbated with Dolby 5.1 surround sound—the perception of the problem is worse in multi-channel sound than it is with just a simple stereo output," said CCTA's Michelle Beck. "There is a period where it could get a lot worse before it starts to turn around. That's because you've got such a huge gap, a wide mix of analog and digital now. When we move to an all-digital environment where we actually have the tools to automate this, and control it more actively at the broadcaster level, we feel that eventually it will get much better."

From Cinema to Television

As audio levels continue to rise across all media, loudness levels have increased even more in theatres with movies that sooner or later end up on broadcast television. The chain of production goes back to the movie studios.

"The people making the movies tend to make them too loud," said Dolby's Todd. "They mix them too loud. What's happening is the owners of the cinemas are getting complaints from the audience, the guys in the cinema are simply turning the volume down and now the guys in the studios are saying well these guys are turning our movies down so we better mix them a little louder, but when they're turned down they come out right. So it's sort of beginning to spiral downwards. We're losing the match between the studio and the cinema, some of the mixers have gone overboard, the cinemas are fighting back, the film makers do not want the cinemas to have control over the reproduction, 'they should present the movie as we decided it should be', but the audience doesn't like the way they're deciding it should be. This is an area of contention."

One of the most egregious abuses of audio loudness occurs in movie trailers—similar to commercial advertising levels on broadcast television. The volume of the movie trailers reached such a level of loudness that the (U.S.) theatre industry instituted a certification process for movie trailers with a highest-acceptable volume level. Any trailer that doesn't pass, doesn't run.

According to Dolby's Todd, the acceptable level for trailers started at 95 decibels and has been moved downwards on a regular basis. It is estimated that audio levels of 90 decibels can begin to cause hearing loss, and according to Ontario's Occupational Health and Safety Act noise levels on the job should not exceed 90 decibels (dB)—the equivalent of a power lawn mower—over eight hours of a 24-hour period.

But, in fact, measuring "how loud is loud" and "how loud is too loud" is set to become a major health issue. Changes in audio levels of about 1.25 decibels are the smallest changes that human hearing can detect. In 2003, CBC-TV's *Marketplace* measured movie levels and found the five popular movies they tested average between 70 and 78 decibels. *Marketplace* found that "they (the movies tested) peaked as high as 95 decibels in *The Lord of the Rings* and 93 in *Harry Potter*—equivalent to standing next to a working leaf blower."

According to a hearing loss Web site, "A German magazine called *Computerbild* recently tested 16 mobile phone games, of which only one met government noise guidelines. The loudest of the games reached a hair cell (of the inner ear) destroying sound level of 133 dB. This is comparable to standing near a screaming jet engine without ear protection, and is well past the 120 dB pain threshold."

Another statistic: "According to the U.S. Environmental Protection Agency, being regularly exposed to sound levels above 70 decibels—roughly the level of using a hair dryer, vacuum cleaner or gas lawn mower—can begin to damage hearing."

The New York State Vehicle and Traffic Law sets unacceptable noise levels at between 72 dB and 90 dB. The town of Conesus, New York, has even set 90 dB as the level governed by a city nuisance noise law.

But perhaps the most critical reasons to begin to govern audio levels are that:

1) constant noise levels contribute massively to over-all stress, which takes its toll on both individual and community health, and
2) hearing loss is unrecoverable; once the hair cells of the inner ear are damaged or destroyed, they don't grow back. The effect is cumulative, almost imperceptible over time, and permanent.

For those in their middle years, the first generation to grow up with rock 'n roll and large-scale concert venues, the damage has already begun. For today's generation of teenagers, it is reported that the damage is already even greater.

So find out the proper settings for the audio and television equipment you use and turn that volume down—you'll be able to hear a lot better for a lot longer.

Senior writer Daphne Lavers is a Toronto-based freelancer. She may be reached by e-mail at dlavers@passport.ca.