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Acoustics team documents crowd noise effect on opposition

Monday, October 29, 2007

How loud was the crowd at Beaver Stadium on Saturday?

"They were a lot louder earlier in the game," said Andrew Barnard -- and he has more than anecdotal evidence to back up his assertion. While Joe Paterno led the Nittany Lions on the field, Barnard, a doctoral candidate in acoustics and research assistant in the Applied Research Laboratory's structural acoustics department, led a team of his own on the sidelines, measuring the noise levels throughout the game.

"The loudest level we recorded was a peak sound pressure level (SPL) of 122 decibels (dB). That is loud enough to cause physical pain on the ear drum," Barnard said. "The crowd only achieved these levels for very short bursts, on the order of 10 milliseconds. The loudest SPL we recorded averaged over a second or more was about 110 dB."

By the fourth quarter, with Penn State trailing the Buckeyes, noise readings were down around the 80 to 90 decibel range, roughly equivalent to a noisy vacuum cleaner or a motorcycle. At that level, the Buckeyes were able to communicate fairly easily with raised or very loud voices at distances up to 32 feet. The highest noise reading recorded in the fourth quarter was 100 decibels, which is equivalent to a riding lawn mower and makes communication difficult, but possible by shouting.

The acoustics exercise, while interesting, also serves some practical purposes for Penn State.

In addition to measuring the sound, the team made mono and stereo recordings of crowd noise for the football team to use in their practice facility. The recordings are calibrated to enable crews to set up the speaker system to play crowd noise at the same levels or slightly louder that it was at the game to help the team prepare for upcoming away games at loud stadiums.

The acoustics team also is able to use the data to evaluate the effects of crowd noise on the opponents, and to educate football fans about the amount of noise they create and how that affects communication among the players on the field.

"We recorded almost the entire game, so we will have lots of interesting data to look at," Barnard said. "The one thing we did notice immediately was the stark difference between when Penn State was on offense and defense. When Penn State was on offense and the quarterback was calling plays, the SPL measured near the student section was about 80 decibels (dB). When the Ohio State quarterback was calling plays at the line of scrimmage, the crown noise was about 110 dB."

Decibels are logarithmic, so an increase of 20 dB is like increasing the SPL by 10 times. An increase of 30 dB is an increase in the SPL of about 30 times. That



Photo by Annemarie Mountz

Special handheld devices were used to record noise levels on the sidelines. By the fourth quarter, the crowd was measurably quieter than at the start of the game.



To the Best of My Knowledge



AP News feed, College of Communications programming

means the crowd increases in SPL output by 30 times when the opponents are trying to call plays.

What does that amount to for communication on the field? "When the Penn State quarterback is shouting plays, he can be heard and understood roughly 32 feet away. When the Ohio State quarterback was shouting plays, he could only be heard and understood about 1.5 feet away. This means that their offensive tackles, tight ends, receivers, and running backs likely couldn't hear the snap count or audibles. That's a pretty stark difference, and I think it shows that the Penn State crowd is well-educated on when it pays off for them to loud and when it pays to quiet down."

Barnard's team members on Saturday were: Lance Locey, doctoral student in acoustics; Jason Bostron, master's student in acoustics; Stephen Hambric, acoustics faculty member, Barnard's adviser and department head of the ARL Structural Acoustics Department; and Anthony Atchley, Acoustics Department chair.

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