False-teeth sensors reveal tongue's twists

12:18 20 May 2008 by **Tamsin Osborne**

Dentures fitted with sensors that record pressure exerted by the tongue are giving researchers an insight into the hidden subtleties of the organ's role in producing speech.

The data they collect could help design better voice synthesisers, or make false teeth and braces that interfere less with speech.

"The aim is to try to understand how humans are able to speak by modelling the speech-production apparatus," says Yohan Payan, a researcher at the TIMC lab near Grenoble, France, and part of the team who worked on this project.

Knowing the pressure the tongue exerts on the teeth during some speech, for example when making a "T" sound, has been particularly difficult, says Payan. "This closure of the vocal tract allows you to pronounce this consonant," he explains. "To model this, you have to be able to estimate the level of force applied by the tongue."

Tailor-made teeth

Previous attempts to record those forces involved sticking sensors to people's teeth, or embedding them into an artificial palate. But both those approaches interfere with the normal workings of the tongue.

Instead, the French team hid their sensors inside dentures made for 20 volunteers who had already lost their teeth.

Individual devices were tailor-made for each patient, with one or two sensors embedded inside. These were positioned on the palette to record tongue pressure when particular consonants were pronounced.

A wire running along the inside of the cheek, well away from the tongue, ferried the output to a computer, while the sounds a person made were simultaneously recorded using a microphone.

'Neat trick'

With the physiology of the mouth largely unchanged, the patients could speak normally while the measurements were being taken. They were asked to recite tongue twisters - phrases that are designed to be difficult to articulate rapidly - to generate the results.

"This is a neat trick; a new twist on a methodology that has been around for some time. The idea of using denture patients in this way is clever," says Joe Perkell, a researcher in MIT's Speech Communication Group in Cambridge, Massachusetts, US.

The researchers have so far published results on the production of the sound "T", and are now turning their attention to other vocalisations. "We could use up to five sensors at the same time in this device," says team member Christophe Jeannin, adding that they also plan to recruit more volunteers for the forthcoming work.

Artificial voices

In the long term, Payan hopes that they will eventually be able to synthesise more realistic human speech than is currently possible.

"When you hear a [voice synthesiser], you can recognise that it's not a human

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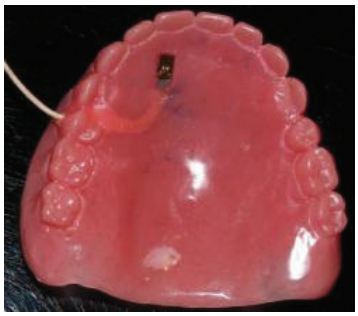

A set of dentures with pressure sensors inside can reveal the tongue's hidden movements during speech - finding out its role in talking could help design more realistic synthesised voices (Image: Christophe Jeannin)

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voice, it's a kind of humanoid voice," he says. A better understanding of the mechanisms of speech will enable the team to incorporate the unique features of human speech into these models.

Perkell agrees. "If used carefully, this technique could help provide some interesting new information about speech production," he told **New Scientist**.

The work could also help design dentures and orthodontic braces that have less impact on a patient's ability to speak normally, says Payan.

Journal Reference: *Materials Science and Engineering: C* (DOI: 10.1016/j.msec.2007.10.079)

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