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An Ultrasound Probe Headset Prototype with Damper for Speech Research

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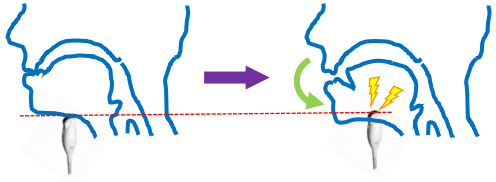
Background & Aim

- Many headsets holding the ultrasound probe for speech research were designed to keep the probe in a constant position relative to the head.
- The probe tip can dig into the skin when the mouth is open in such headsets.



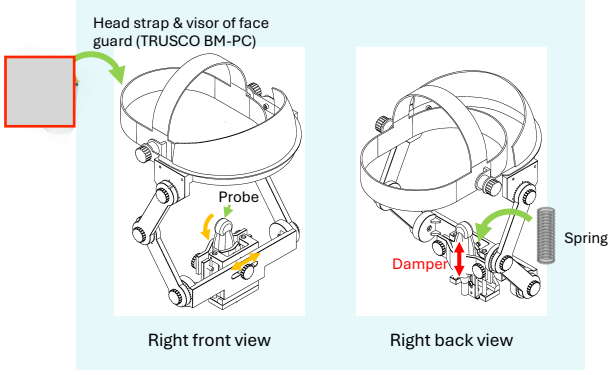
The position of the probe relative to the lower jaw is unstable [1].

The probe can restrict the movement of the lower jaw.

Aim: To develop a probe headset with a damper in the probe clamp.

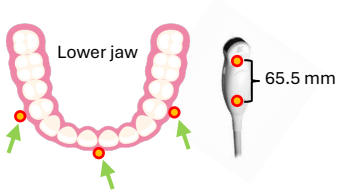
Proposed Headset

- The proposed headset has a damper with a spring attached to a probe clamp.
- The horizontal position of the probe clamp is adjustable.
- The orientation of the probe can be turned in the sagittal and coronal direction.



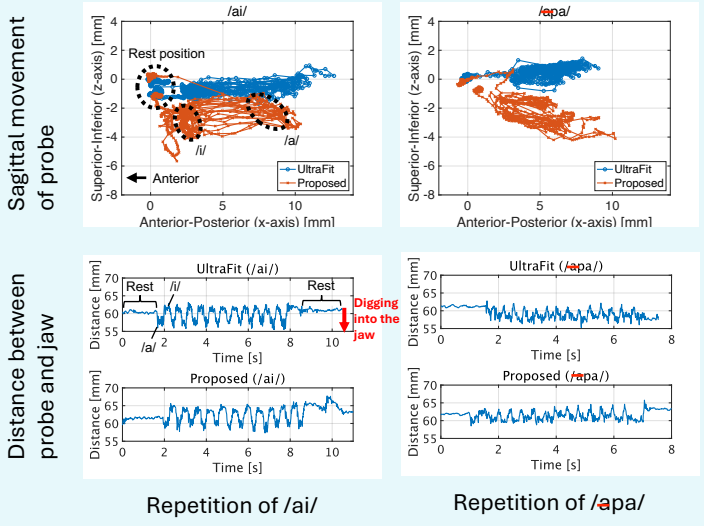
Method of Evaluation

- Participant: A male native Japanese speaker
- Task: Repetition of /ai/, /pa/, /ta/, and /ka/
- Headset: (1) UltraFit [2] and (2) proposed headset.
- Method:
  - 3D position of the probe relative to the nasion and mandible was measured by NDI Wave system.
  - Reference (6DOF) sensor: Nasion
  - 5DOF sensor: Lower incisor, premolar teeth, and probe
  - Sampling rate: 100 Hz



5DOF sensor position

Results



	UltraFit	Proposed
Allow jaw movement (anterior-posterior)	✓	✓
Allow jaw movement (superior-inferior)	✗	✓
Keep constant distance between the probe and jaw	✗	✗
Probe does not dig into the skin*	✗	△

* The participant felt less pain when he used the proposed headset than when UltraFit fixed the probe.

Conclusions

- This study developed an ultrasound probe headset prototype that allowed the probe to follow the lower jaw movement by the damper of the probe clamp.
- Preliminary feasibility test using the EMA system showed
  - The proposed headset allows the lower jaw to move more freely.
  - The proposed headset needs to improved to keep the constant distance between the probe and lower jaw.
- Next steps:
  - To find the appropriate physical properties of the springs for the probe holder.
  - To compare the articulatory motion with and without the headset.

References

[1] Chen, W.-R., Stern, M. C., Whalen, D.H., Derrick, D., Carignan, C., Best, C. T., Tiede, M., 2024. Assessing ultrasound probe stabilization for quantifying speech production contrasts using the adjustable laboratory probe holder for ultrasound (ALPHUS), *J. Phonetics*, 105, 101339.

[2] Pucher, M., Klingler, N., Luttenberger, J., Spreafico, L. 2020. Accuracy, recording interference, and articulatory quality of headsets for ultrasound recordings, *Speech Communication*, 123, 83-97.

Acknowledgments

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