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Dr. Chi-Te Wang received his MD degree from the National Taiwan University, Taipei, Taiwan, in 2003. After resident training from 2003 to 2008, he joined Far Eastern Memorial Hospital as an attending physician. He received PhD degree from the Institute of Epidemiology and Preventive Medicine at National Taiwan University in 2014. During his professional carrier, he visited Mount Sinai Hospital (NYC, 2009), Mayo Clinic (Arizona, 2012), Isshiki voice center (Kyoto, 2015), UC Davis voice and swallow center (Sacramento, 2018), and UCSF voice and swallow center (San Francisco, 2018) for continual exposure on the expertise practice. He is a corresponding member of the American Laryngological Society and member of councils on the Taiwan Otolaryngological Society and Taiwan Voice Society. He has a wide clinical and academic interest, and has published a dozen papers on different fields, including phonosurgery, automatic detection and classification of voice disorders, real time monitoring of phonation, and telepractice. He is the inventor of multiple international patents on voice detection, classification, and treatments. He co-hosted Big Data Cup Challenge on 2018 and 2019 IEEE International Conference on Big Data. He is the winner of Society for Promotion of International Oto-Rhino-Laryngology (SPIO) Award on 2015, Best Synergy Award of Far Eastern Group on 2018, and National Innovation Award of Taiwan in 2019.

Ambulatory Phonation Monitoring Using Wireless Microphone Based on Energy Envelope

Dr. Chi-Te Wang

Voice disorders mainly result from chronic overuse or abuse, particularly for teachers or other occupational voice users. Previous studies have proposed a contact microphone attached to the anterior neck for ambulatory voice monitoring; however, the inconvenience associated with taping and wiring, and the lack of real-time processing has limited its daily application.

Starting from 2015, we founded a research group collaborating with experts from National Yang-Ming University, Yuan Ze University and Far Eastern Memorial Hospital. We proposed an system using wireless microphone for real-time ambulatory voice monitoring. We invited 10 teachers to participate in the pilot study. We designed an adaptive threshold (AT) function to detect the presence of speech based on energy envelope. All the participant wore a wireless microphone during a teaching class (around 40-60 minutes), in quite classroom (background noise < 55dB SPL). We developed a software for manually labeling speech segments according to the time and frequency domains. We randomly selected 25 utterance (10 s each) from the recorded audio files for calculating the coefficients for AT function via genetic algorithm. Another five random utterances were used for testing the accuracy of ASD system, using manually labeled data as the ground truth. We measured phonation ratio (speech frames / total frames) and the length of speech segments as a proxy of phonation habits of the users. We also mimicked scenarios of noisy backgrounds by manually mixing 4 different types of noise into the original recordings. Adjuvant noise reduction function using Log MMSE algorithm was applied to counteract the influence of detection accuracy.

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The study results exhibited detection accuracy (for speech) ranging from 81% to 94%. Subsequent analyses revealed a phonation ratio between 50% and 78%, with most phonation segments less than 10 s. Although the presence of background noise reduced the accuracy of the ASD system (25% to 79%), adjuvant noise reduction function can effectively improve the accuracy for up to 45.8%, especially under stable noise (e.g. white noise).

This study demonstrated a good detection accuracy of the proposed system. Preliminary results of phonation ratio and speech segments were all comparable to those of previous research. Although wireless microphone was susceptible to background noise, additional noise reduction function can overcome this limitation. These results indicate that the proposed system can be applied to ambulatory voice monitoring for occupational voice users.