Carnegie Mellon University

DeWinder: Single-Channel Wind Noise Reduction using Ultrasound Sensing

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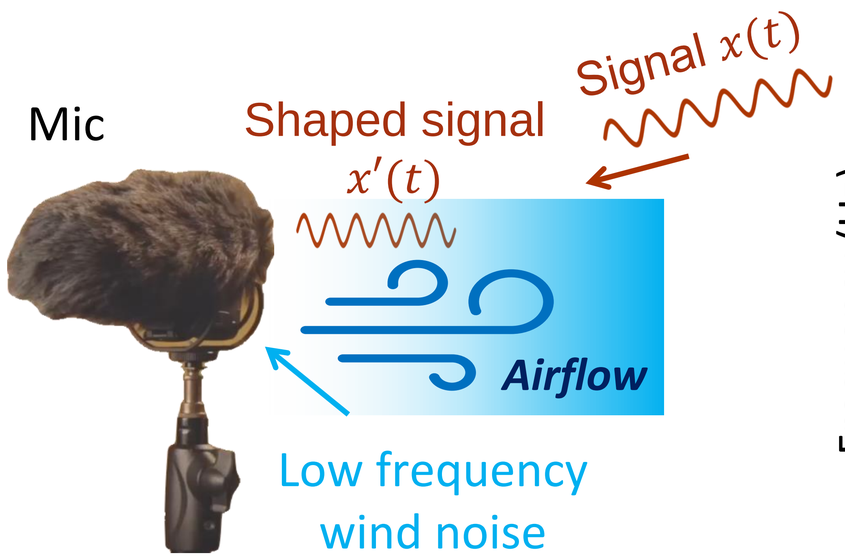
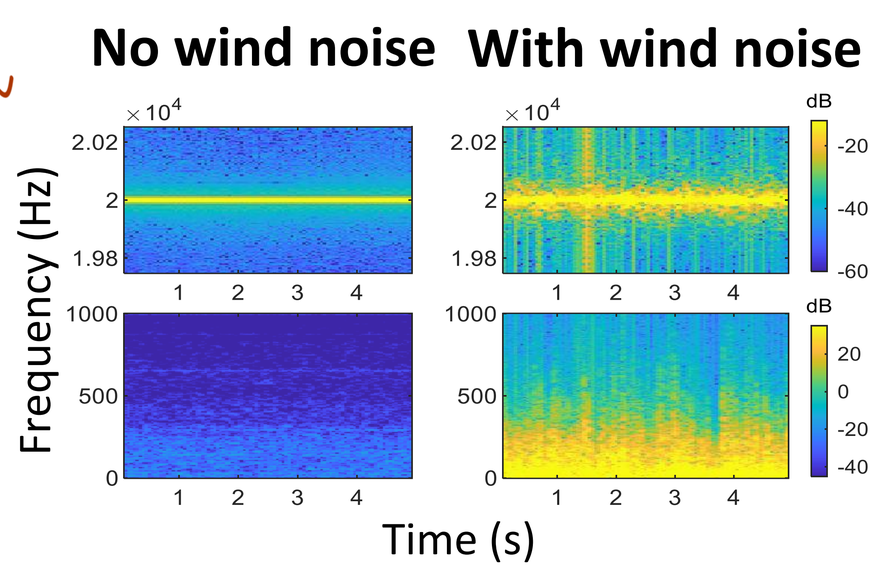
Motivation

Airflow not only induces **wind noise**, but also **shapes acoustic signal transmissions**, because of the *Doppler Effect*.





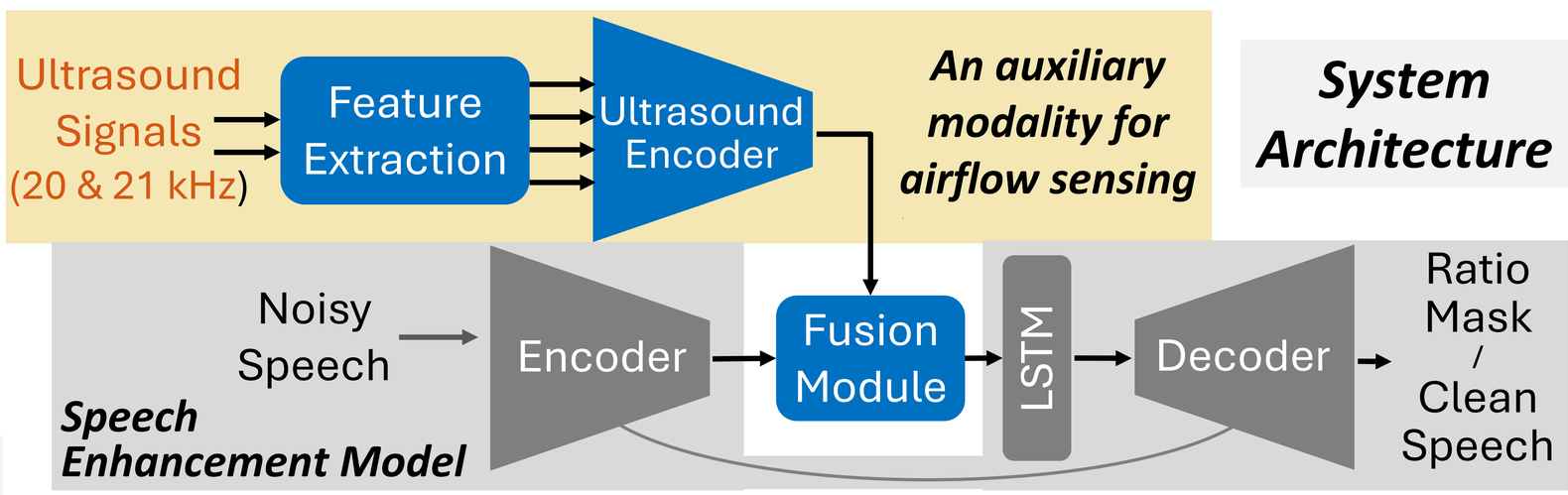
Can we use a dedicated signal to **sense and characterize the real-time airflow** and enable **more informative wind noise reduction**?

Overview

Hardware Setup

Ultrasound Signal at around 20 kHz

- Not Audible
- Can be captured by normal mic (44.1 kHz)



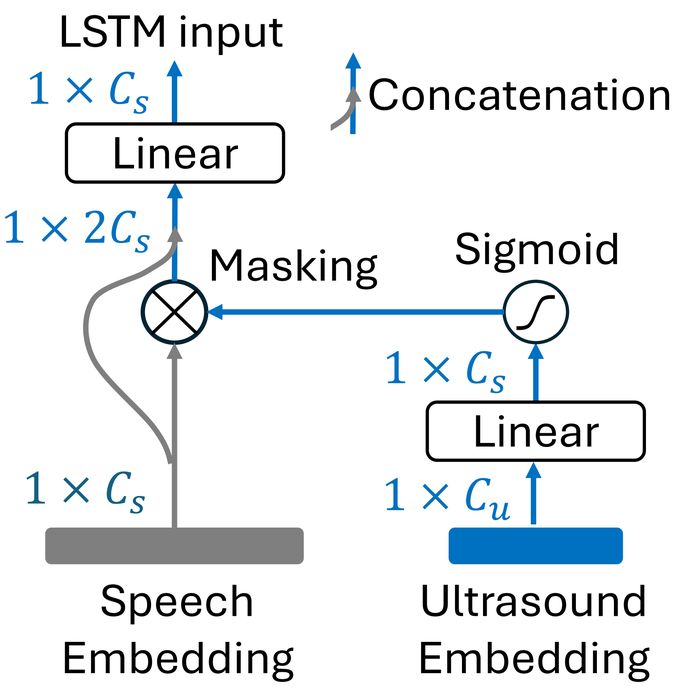
Speech-Ultrasound multi-modal fusion

- Feature Extraction: Demodulation + Multi-step filtering
- A modular frameworks can adapt to different SE models

Models & Fusion

	Domain	Outputs	Fusion Module
DCCRN	Time-Frequency	Complex Ratio Mask	Concatenation
DEMUCS	Time	Clean Speech Waveforms	Masking-based

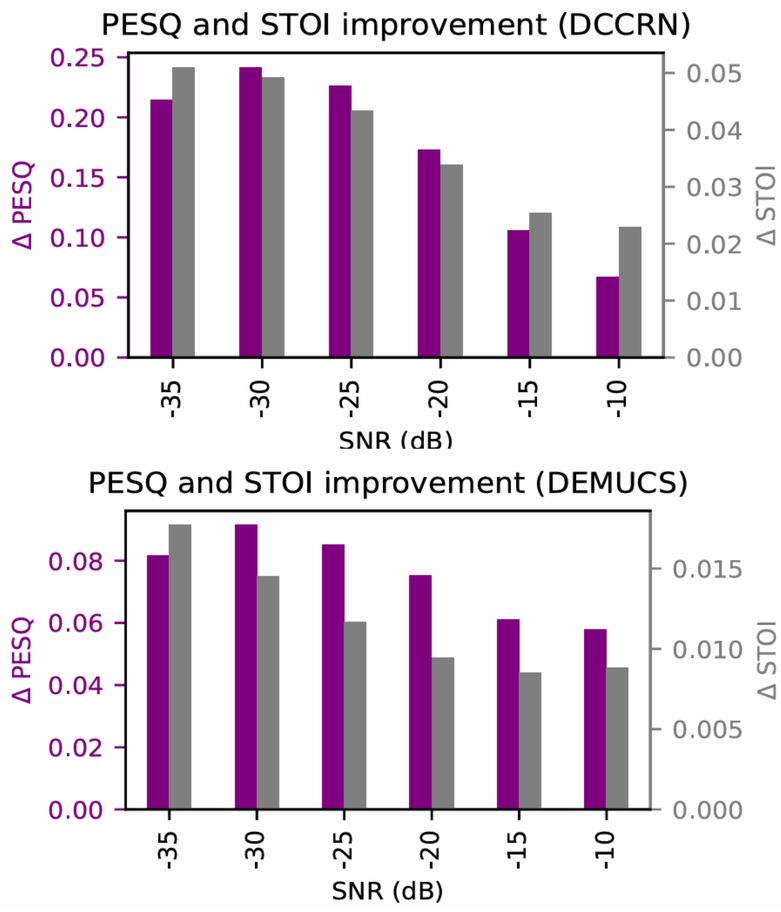
Masking-based Fusion



Masking out the wind noise information from the speech embedding

Results

	SI-SDR	PESQ	STOI
DCCRN	2.685	2.265	0.653
+ DeWinder (1 channel US)	3.841	2.470	0.696
+ Dewinder	**3.871**	**2.480**	**0.700**
DEMUCS	6.632	2.776	0.812
+ DeWinder (1 channel US)	6.902	2.855	0.826
+ Dewinder	**6.932**	**2.861**	**0.827**



DeWinder improves the wind noise reduction performance for speech enhancement models, especially in low-SNR conditions

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