## PCA Feature Space Analysis: Model Clustering and Protocol Separation **PCA Explained Variance** 16.6% Enhanced (LOSO) 0.16 Enhanced (LORO) CNN (LOSO) 0.14 CNN (LORO) 11.7% 11.3% BiLSTM (LOSO) 10.6% BiLSTM (LORO) 9.3% 8.8% 8.2% Conformer-lite (LOSO) Conformer-lite (LORO) 2 Noise Resilience Second Principal Component (11.7% variance) 0.02 0.00 10 Principal Component Model Separation Distances Frequency\_Response 0.0 0.7 Enhanced 0.7 0.0 0.4 0.9 CNN -20.4 0.4 0.0 BiLSTM 0.9 0.4 0.0 Conformer-lite -32 First Principal Component (16.6% variance) **Cross-Protocol Consistency Analysis 3D Feature Space** LOSO-LORO Distance (Lower = More Consistent) 3.5 3.0 3.0 3.0 1.5 1.0 0.0 0.0 3.45 Enhanced CNN BiLSTM PC3 0.71 0.28 0.25 -2 РС1 BiLSTM Enhanced CNN Conformer-lite