

Supplementary Material D: Detailed Qualitative and Interpretability Results

INTERMEDIATE FEATURE VISUALIZATION (T-SNE)

To assess the effectiveness of our causal feature extraction and meta-learning strategy, we visualized the intermediate features using t-SNE (t-distributed Stochastic Neighbor Embedding). Figure S1 shows how the model separates different flight incident classes in the latent feature space.

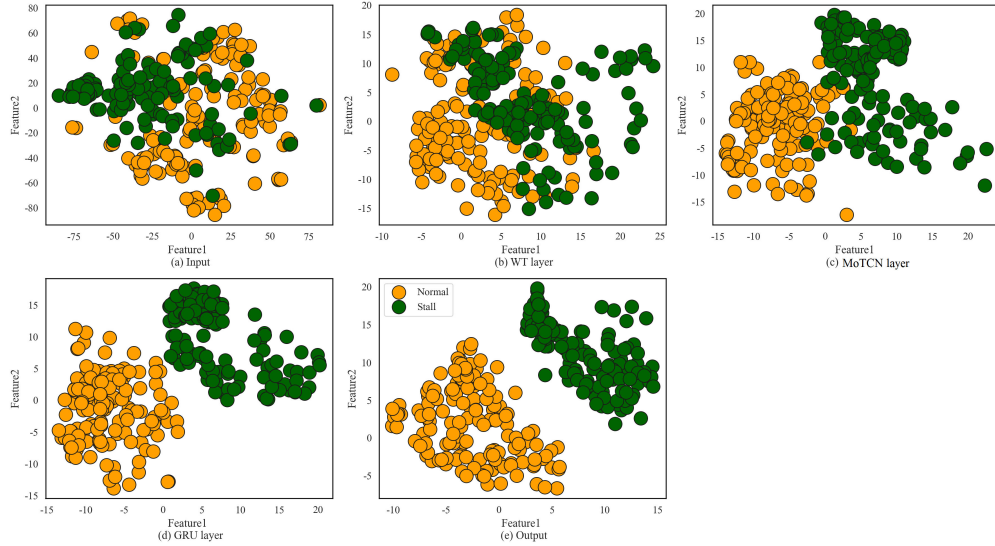


FIG. S1: Visualization of model intermediate features using t-SNE.

REAL STALL FLIGHT TEST DATA

To provide context for the online precursor warning experiments discussed in the main paper, Figure S2 visualizes a typical power-off stall flight test scenario, highlighting key parameter changes, including Angle of Attack, Airspeed, and Pitch angle. The timing of

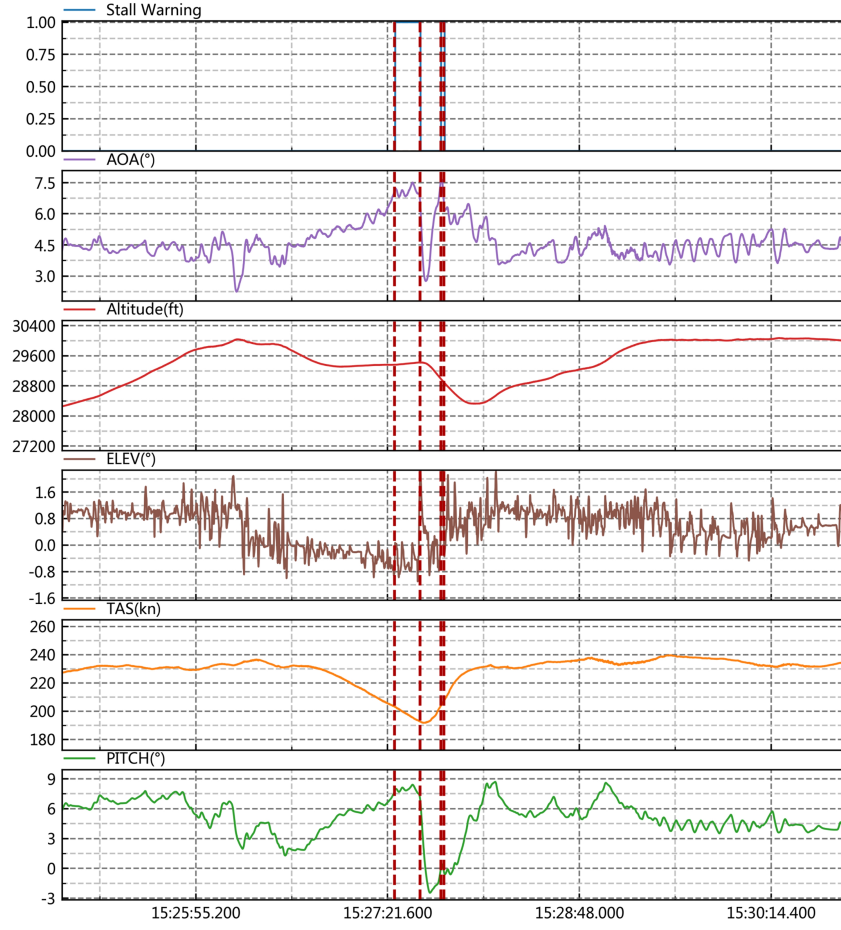


FIG. S2: Visualization of real stall flight test data. The red dashed line indicates the stall warning.

the aircraft's original stall warnings is illustrated as red dashed line. This visualization demonstrates the complex, multi-stage nature of high angle-of-attack incidents, which our model is designed to detect in advance.