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Supplementary Material D: Detailed Qualitative and 2 Interpretability Results

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INTERMEDIATE FEATURE VISUALIZATION (T-SNE)

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

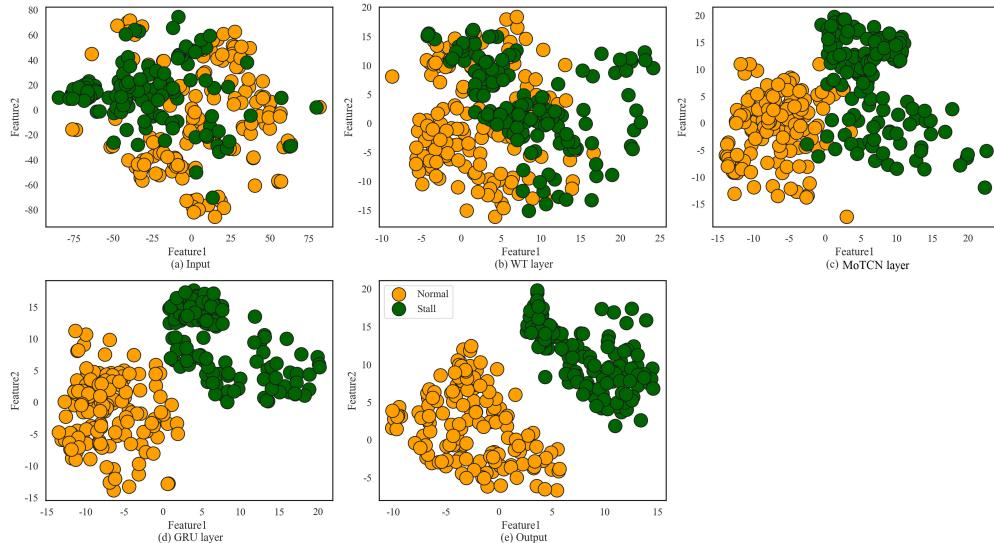


FIG. S1: Visualization of model intermediate features using t-SNE.

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REAL STALL FLIGHT TEST DATA

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

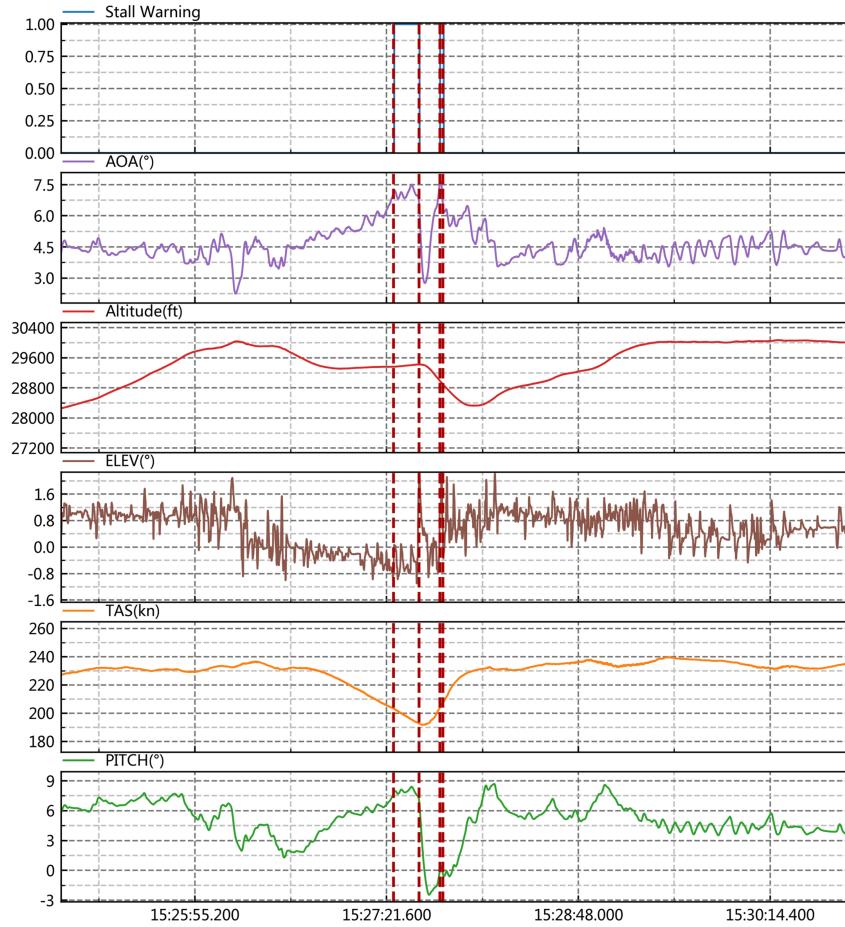


FIG. S2: Visualization of real stall flight test data. The red dashed line indicates the stall warning.

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