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Data-Driven Identification For Vortex-Induced Vibrations With Imbalanced Data

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Accurate monitoring for vortex-induced vibrations (VIVs) is pivotal in the vibrational serviceability assessments of long-span bridges. Even though several data-driven methods for identifying VIVs have been developed in recent years, there are still challenges in applying these approaches to real-world problems. Typically, the number of VIV events (anomalies) is extremely small compared to the non-VIV dataset (normal states); such learning from imbalanced data may consequently degrade the model performance. In this regard, this study investigates the feasibility of data-driven VIV identification frameworks trained by imbalanced data, where only non-VIV datasets are available. The proposed frameworks address this challenge by (1) a one-class regression model, (2) minority data augmentation, and (3) an unsupervised learning method, respectively. In the parametric studies, several suggestions (i.e., oversampling, parameter optimization, feature engineering) are made to improve the predictability of models with limited information. The proposed frameworks are then demonstrated to identify VIVs using actual monitoring data from cable-stayed bridges. Last, the pros and cons of the proposed frameworks are examined based on their identification performances.