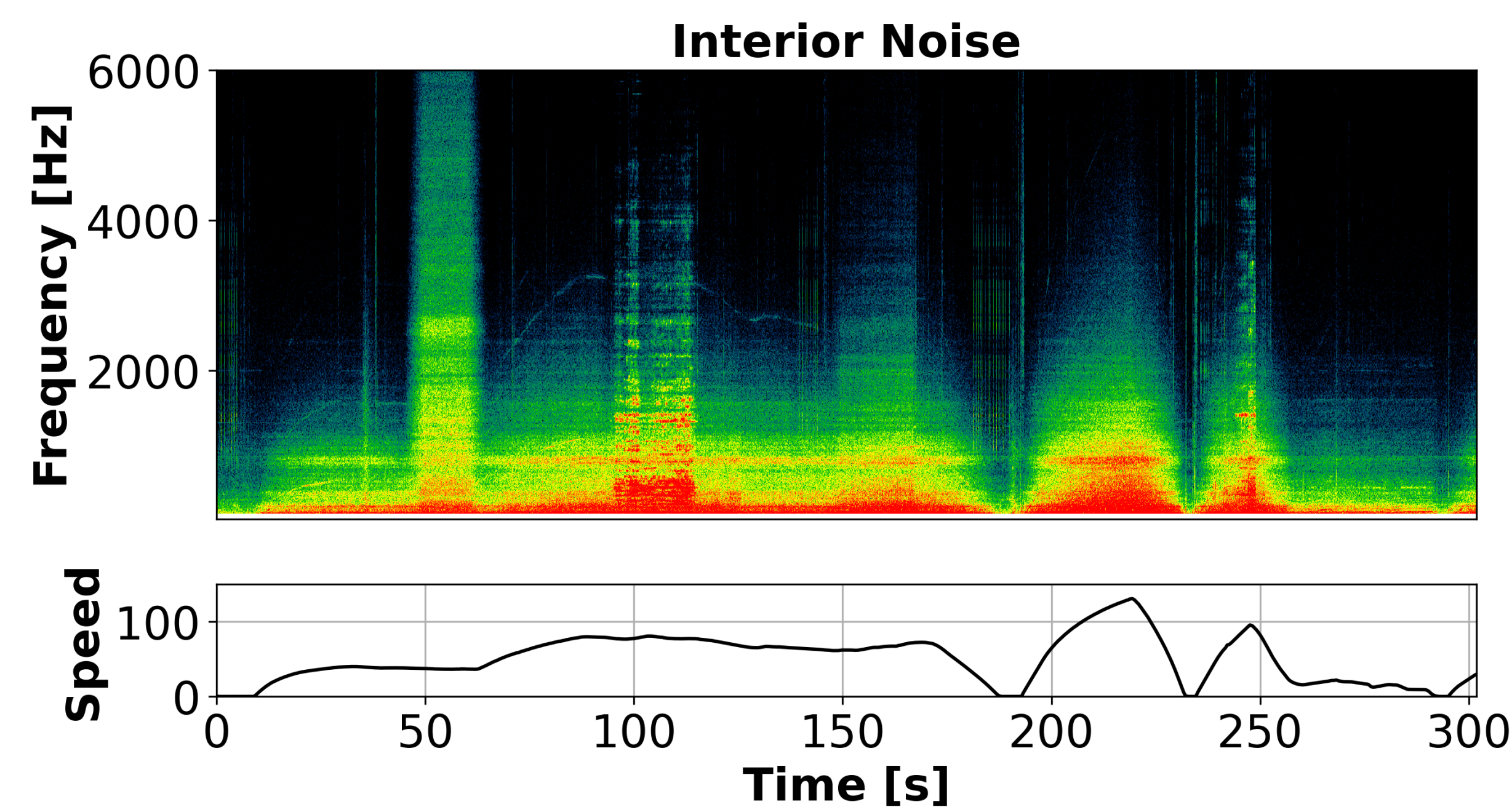


Human Senses Mimicking: Vibro-Acoustic Signature Detection

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Scope

OEMs rely on Noise, Vibration, and Harshness (NVH) engineers to evaluate the projected passenger experience of personal cars. As mobility shifts towards sustainable solutions and Mobility-as-a-Service, automatic monitoring systems without human involvement is needed to assess passenger comfort and detect abnormal system behavior.



Objectives and Challenges

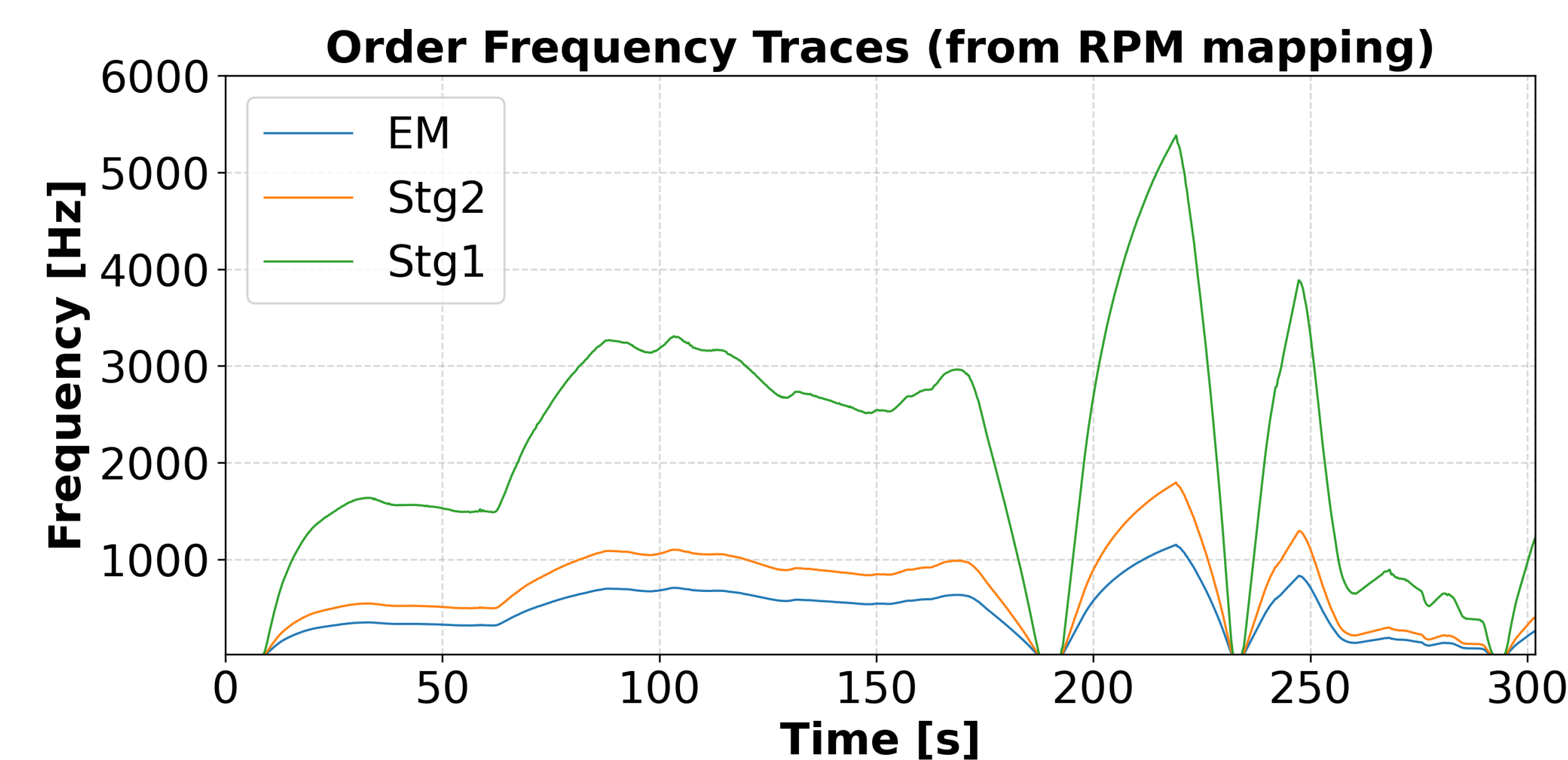
- ✗ Real-time characterization of the interior soundscape.
- ✗ Identify expected and unexpected noise and vibration events.
- ✗ Provide relevant information about detected anomalies for root cause analysis.

Key challenges include:

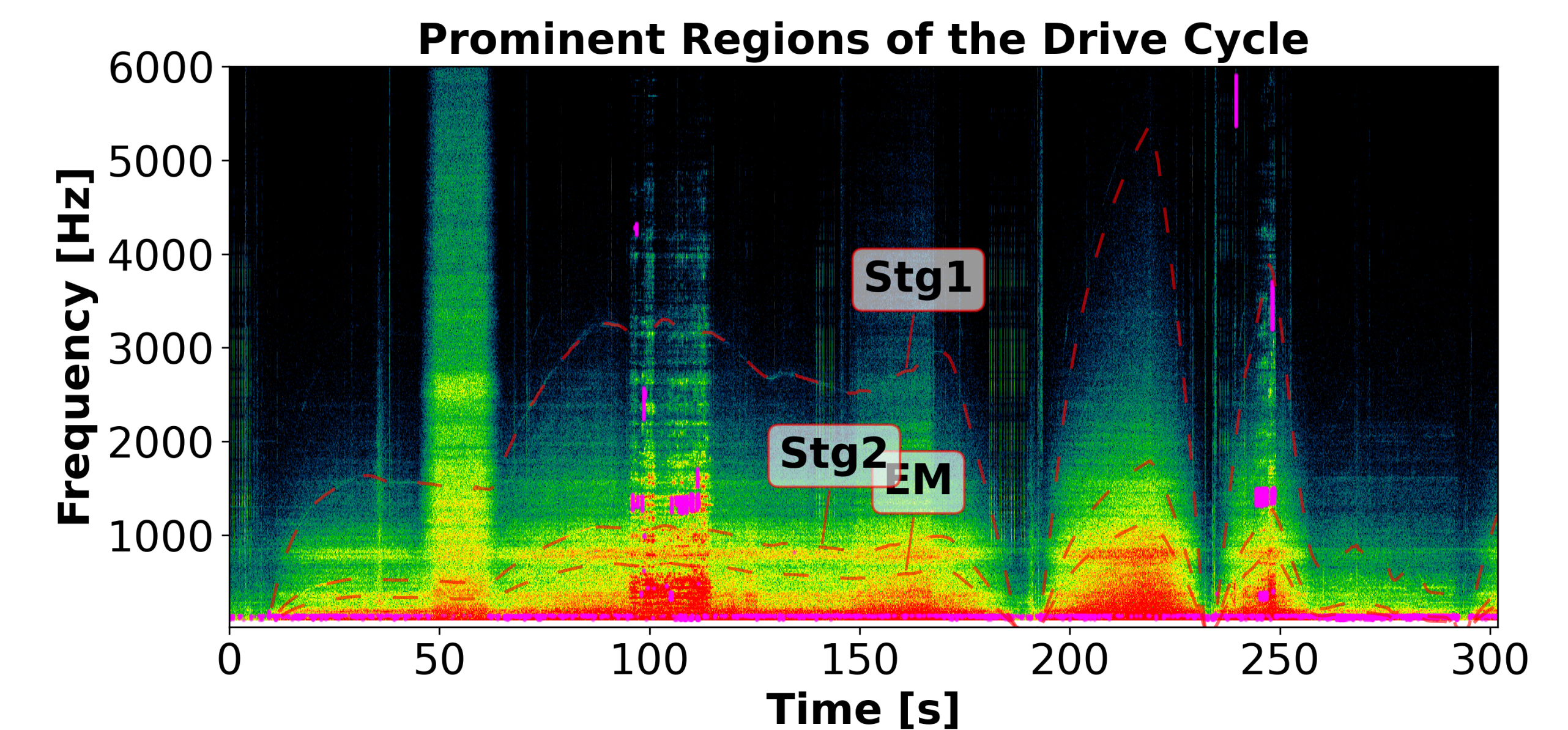
- ✗ Limited temporal context: Traditional frequency-based detectors process each time frame independently, making them prone to errors when tones are intermittent, masked, or evolving.
- ✗ Sensitivity to transients: Rapid changes in speed, load, road surface, or environment can cause misclassification or missed detections.

Illustrative Case Study: Propulsion System

The propulsion system generates tonal components that are characteristic of the drivetrain but can be masked by other dynamic noise sources.



A common NVH metric for detection of tonal components is the Prominence Ratio (PR). In the example, a PR sweep highlights prominent tonal regions in magenta.



Despite this automation, several tonal components that are clearly audible in listening tests remain undetected, showing that traditional metrics are insufficient for reliable, fully autonomous interpretation of the soundscape.

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Contributions to SEDDIT Goals

Supporting efficient, reliable EV operation through early detection of vibro-acoustic issues.