精读

mmVib: Micrometer-Level Vibration Measurement with mmWave Radar

Summary

- It proposes a practical approach to measure micrometer-level vibration with mmWave radar (IWR1642).
- It indroduces a Multi-signal Consolidation (MSC) model to describe the properties of the reflected signals, we exploit the inherent consistency among those signals to accurately recover the vibration characteristics.
- The experiments show that this design achieves 8.2% relative amplitude error and 0.5% relative frequency error in median. The median amplitude error is 3.4um for the 100um-amplitude vibration

Novelty and Insight

- It proposes a MSC model to measure micrometer-level vibration using mmWave radar.
- Insight: increasing the number of observations of the same vibration helps to control measurement errors.

Multi-signal Consolidation Model

It describes the reflected signal in the I and Q domain and exploit the inherent consistency among those signals to recover the vibration characteristics.

- Multi-frequency: by changing the starting frequency of the chirps in a frame and get multiple observations of a arc in the I/Q domain.
- Multi-antenna (Rx): not only provides multiple observations but also offer an opportunity to refine the measurement.

Strength

- mmWave radar to measure the micrometer-level vibration by proposing the MSC.
- The MSC and system design is detailed and well-written.

Weakness

- There is no experiment about higher virbation frequency (above 500Hz) to the measurement.
- what about a larger virbating surface (The impact of a large vibrating surface to the AoA estimation of vibration refinement)?
- What about the vibration mesurement of multiple objects when they fall into the same range-bin (i.e., close to each other).

泛读

Towards Physical-Layer Vibration Sensing with RFIDs

Summary

- This paper proposes TagSound, an RFID-based vibration sensing system that explores a tag's harmonic backscattering to recover high-frequency and tiny mechanical vibrations accurately. (***But the implementation: RFID + USRP***)

Solved problem

- Current RFID-based vibration measurement solution can only sense low frequency (< 100Hz) vibration with larger amplitude (> 5mm).
- TagSound can achieve a mean error of 0.37Hz (f<100Hz) and 4.2Hz(f=2500Hz)

Experimental Setup

- RFID: antenna, ImpinJ Reader, Tag
- ***USRP N210 with 1 directional antenna (Monitor the backscatter signal of RFID)***

Tagbeat: Sensing Mechanical Vibration Period With COTS RFID Systems

Summary

This paper proposes Tagbeat, to inspect mechanical vibration using COTS RFID tags and readers. The proposed system can measure the amplitude and period of mechanical virbation.

Inovation and Solved problem

1. It shows how one can measure the mechanical vibration and discover its period with COTS RFID.
2. It designed a new digital microscope to amplify the micro-vibration-induced weak signals.
3. the proposed system achieves high-frequency vibration inspection with low-read-rate RFID.

Experimental Setup

USRP: ImpinJ Reader and Alien tags.