Advanced Sensing Technologies for Practical UAV-Based Condition Assessment of Underside Bridge Decks

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Sounding the Underside of Bridge Decks

Monitoring the underside of bridge decks is costly, requiring special equipment above and beyond the disruption of traffic and the time of road crews. This project uses a combination of acoustic and microwave sensing methods to inspect the underside of bridge decks without having to shut down traffic.

Figure 1. Delaminated Underside of Bridge Deck (left)
Technician Uses Hammer to Inspect Bridge (right)

Combining UAVs with AAS and Microwave Sensing

The goal of this project is to combine unmanned aerial vehicles (UAVs) with active acoustic sensing (AAS) and microwave sensing to provide an early detection technique of subsurface delaminations before they develop into surface cracks, increasing operator safety, saving time, and ultimately extending the life of the bridge.

Figure 2. Custom UAV as AAS technology platform (left), Frequency spectrum analysis of known void (center), Compact 10 GHz microwave radar sensor (right)

Methodology of Active Acoustic Sensing (AAS)

Current efforts focus on the evaluation of a high-frequency (100 kHz) air-coupled acoustic sensor to convert sounds emanating from a concrete bridge deck following a hammer tap. Time-frequency processing of the signal discerns the presence of delaminations and other subsurface damage conditions.

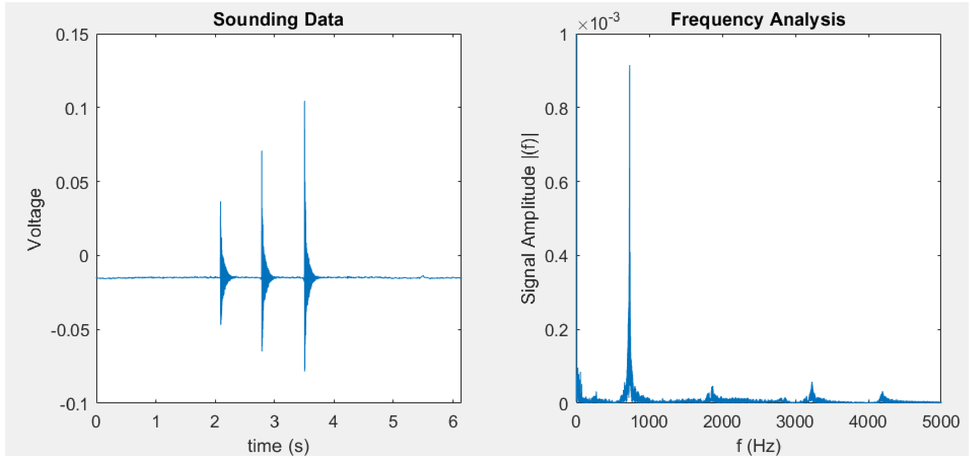

Figure 3. Frequency analysis of test specimen of concrete slab

Next Steps – UAV Integration and Microwave Sensing

The plan is to develop and package acoustic and microwave sensors for detecting delaminations and damage of bridge decks from underneath, placing them on a custom UAV, and evaluating, verifying and improving performance with laboratory and field tests.

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