

Assessment of UAV-deployed Epoxy-bonded Vibration Sensors on Concrete Structures

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Introduction

- Placing sensors for structural health monitoring can be in hard-to-reach areas such as high elevations or waterways
- UAVs enable sensor deployment in hazardous/inaccessible regions for structural monitoring.
- Reliable adhesion is critical for effective structural monitoring, but it is important to evaluate vibration transmissibility loss to ensure accurate sensing.

Methods

- A mountable drone structure for a drone was constructed using aluminum rods and trusses to simulate UAV deployment.
- A small steel plate was bonded to a concrete slab using fast-setting epoxy.
- Accelerometers were mounted on both sides of the slab and an electromagnetic shaker was used to apply controlled vibrations to the concrete slab to measure vibration transmissibility.
- The accelerometers were wired directly to a computer for data acquisition to receive real-time readings.
- Several tests were conducted to measure transmissibility loss including singular frequency tests, sweep frequency tests and impulse tests.
- The data was then processed using Python code and the test with the greatest transmissibility loss was considered.
- This process quantified the vibration transmissibility loss through the adhesive between the concrete slab and sensors.



Image shows UAV used for sensor deployment and sensor package used for data collection.

Results

- Vibration data from the accelerometers showed measurable loss in transmissibility across the adhesion of the sensors.
- The epoxy bonded steel plate onto the structure did introduce signal dampening between the structure and the mounted sensor on the bottom.
- Data confirmed that bond strength and application parameters do influence transmissibility collection.

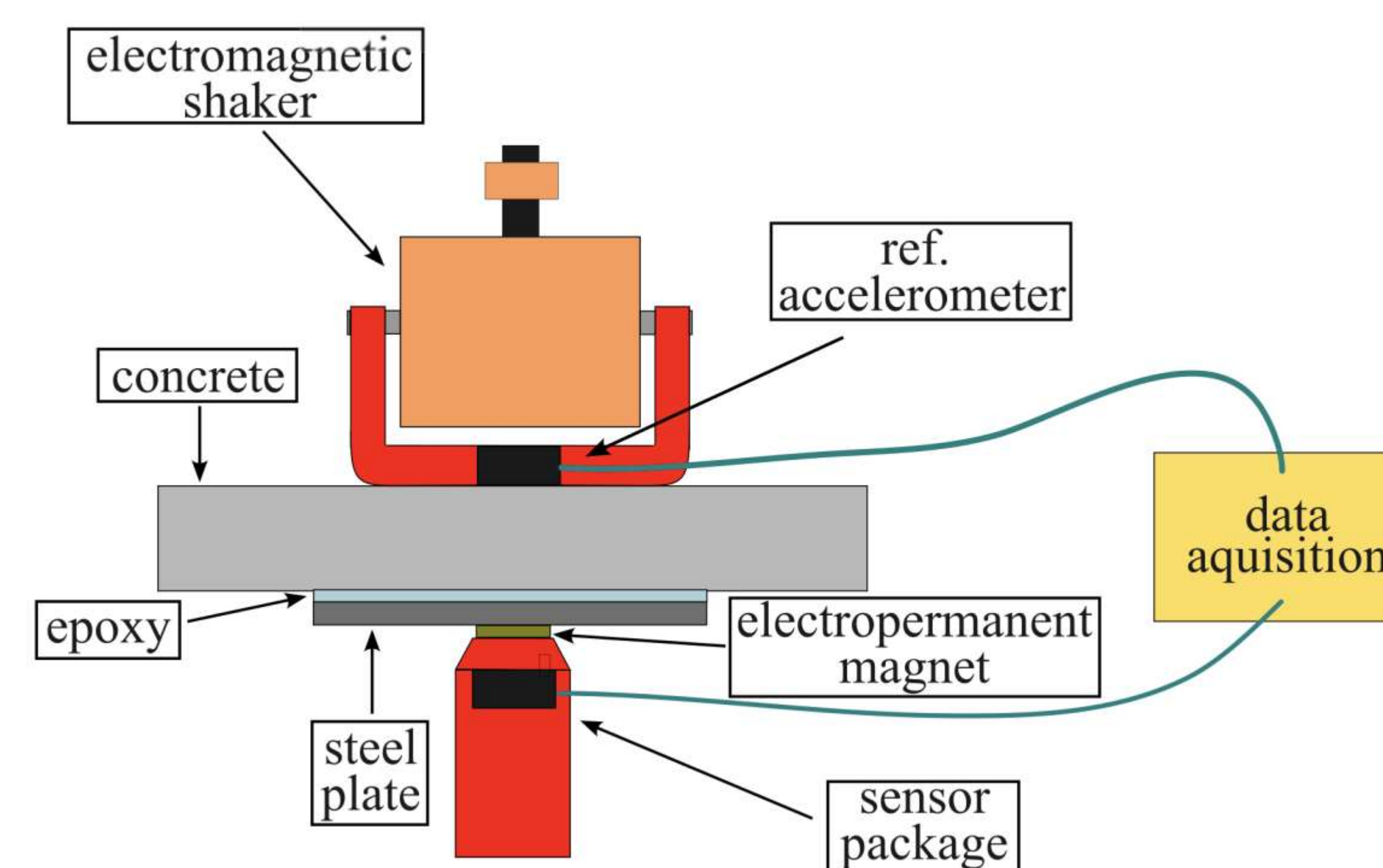


Figure represents the layout in which the data was collected for the experiment.

Conclusions

- UAVs can be used for the deployment of sensors onto concrete structures using steel and epoxy.
- Experimental results do show vibration transmissibility loss through the adhesive.
- Real-time transmissibility loss was analyzed and processed to ensure accurate transmissibility comparisons on each side of the surface.
- This adhesion could be considered a potential approach for autonomous sensor deployment.

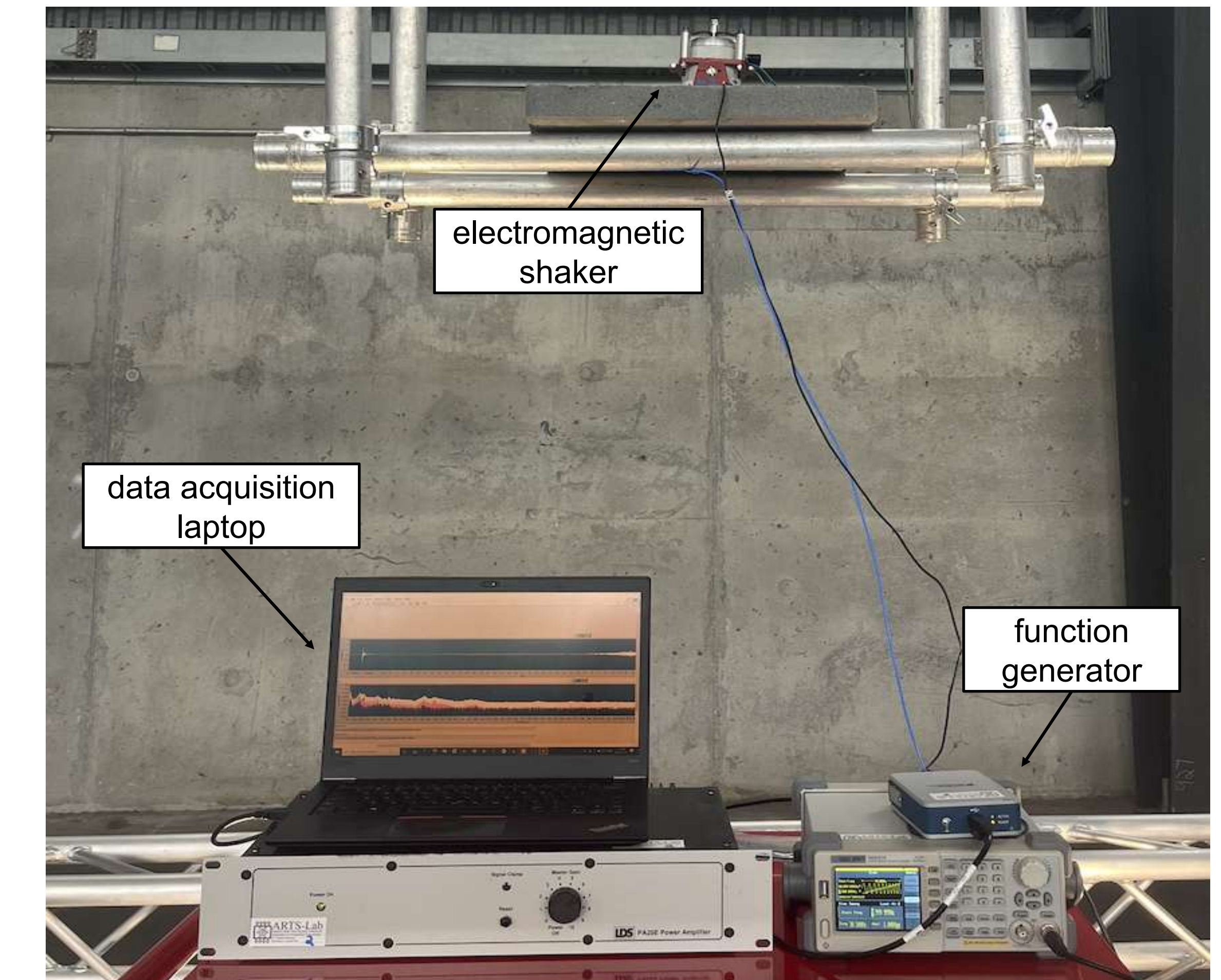
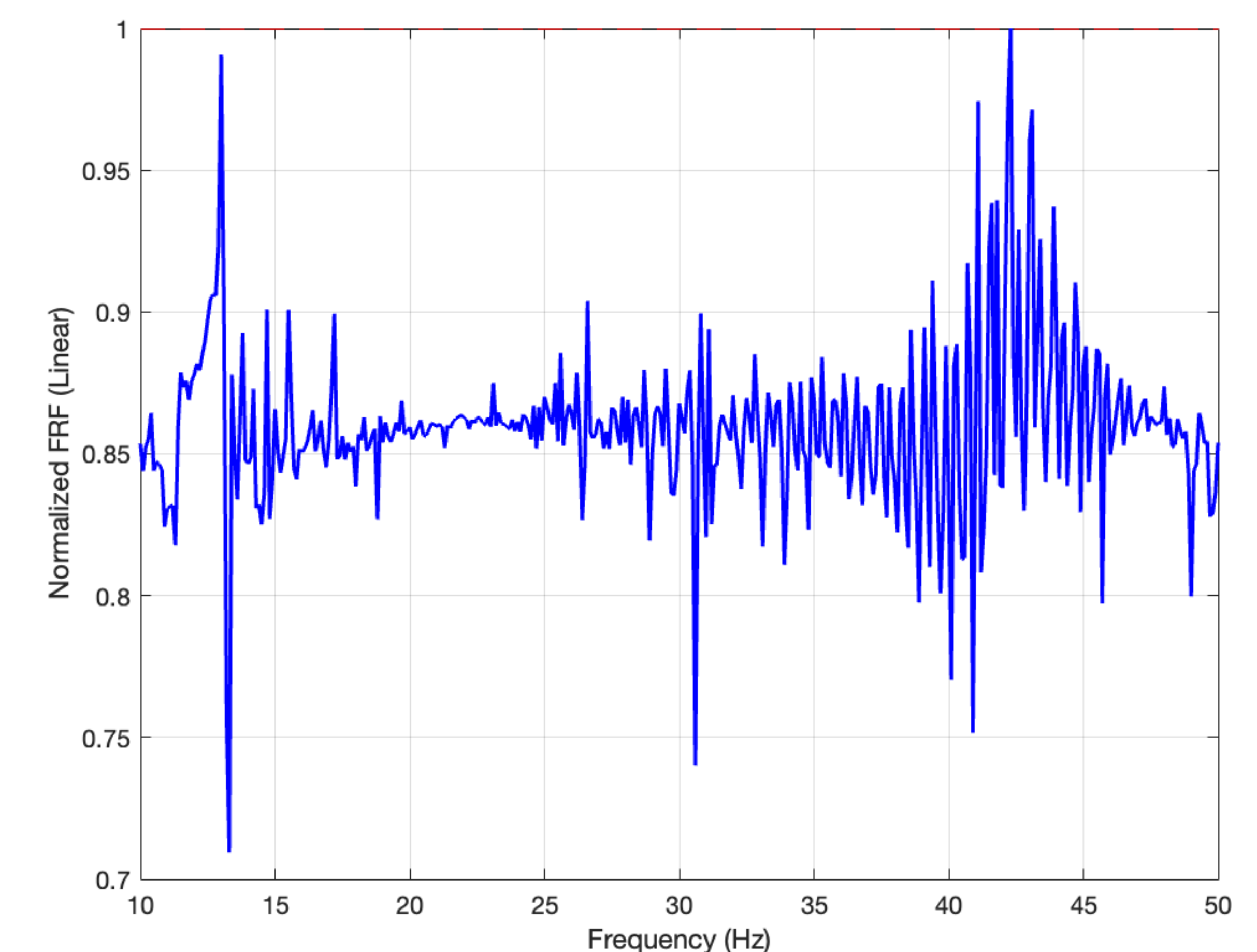


Image shows experimental setup used to acquire input-output data for analysis.



Plot of the frequency response function shows how the system responds to different input frequencies. Peaks indicate where the systems amplifies frequencies the most.

