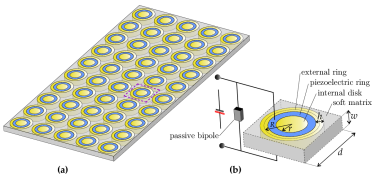
Chair of Vibroacoustics of Vehicles and Machines
School of Engineering and Design
Technical University of Munich

Master's or Semester Thesis

Active Control of Acoustic Metamaterials for Noise Reduction in Aircraft Turbines

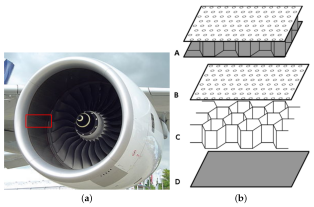
Your Task

Vibration control is a critical and evolving area of research across various industries, including automotive, aerospace, and maritime sectors. Its growing significance stems from the impact of mechanical vibrations, which can both enhance and impair system performance by influencing acoustic properties and altering mechanical behavior. Such effects can affect a system's ability to perform its intended function reliably over time. To address these challenges, a range of vibration control techniques has been developed, broadly classified into active and passive strategies.



Membrane Type Acoustic Metamaterials
Bacigalupo, Andrea, Maria Laura De Bellis and Diego Misseroni. "Design of active acoustic metamaterials with periodic piezoelectric microstructure." Applied Physics (2019)

Recently, active control has been applied to acoustic metamaterials, a class of engineered materials designed to control, direct, and manipulate sound waves in ways not achievable with conventional materials. These materials exhibit unique properties such as effective negative density or stiffness, enabling innovative solutions for noise mitigation. Active acoustic metamaterials enhance these capabilities further by incorporating adaptive elements, such as sensors and actuators, allowing for real-time control of sound propagation. This adaptivity is particularly beneficial in dynamic environments, where noise characteristics vary across a broad frequency range. In contrast, passive metamaterials are typically designed for specific frequencies and rely on their static structural properties to achieve desired acoustic effects. The aim of this study is to investigate the active control of acoustic metamaterials to achieve effective and adaptable noise reduction, with a focus on applications in aircraft turbines, where the acoustic environment is highly variable and demands sophisticated noise management solutions.



Acoustic Liners in Aircraft turbines
Martin, C.A.; Mendez, A.C.; Sainges, O.; Petiot, E.; Barasinski, A.; Piana, M.; Ratier, L.; Chinesta, F. Empowering Design Based on Hybrid TwinTM: Application to Acoustic Resonators. Designs 2020, 4, 44.

Your Skills

- Good knowledge in engineering mechanics and mathematics
- Basic knowledge in control theory
- Basic knowledge in FEM/COMSOL simulations
- High interest in understanding of mathematical equations
- Programming skills in Python or Matlab

Contact

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