Integrated design of phononic structures and flexible forming processes, PSED Cluster 2018-2019

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Academic Disciplines:
Mechanical Engineering

Motivation

Undulated phononic structures can mitigate vibrations. Flexible forming processes will affect the fabricated geometry and should be considered in the design modeling.

Audible vibration sources (*motors, fans, road traffics*) → Mechanical noises (*vehicles, equipments, buildings*)

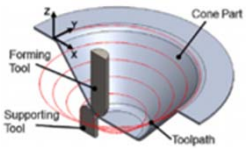
Objective

Integrated design of undulated phononic structures (beams) and incremental sheet forming (ISF) for audible vibration control.

Modeling and results

Parameterized (cubic Bezier curve) shape modelling

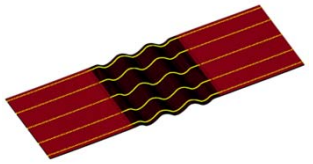
ISF limits
- Max slope: 60°
- Thickness varies with slope



- GA optimization
- Maximize transmission gap in audible range (<20kHz)

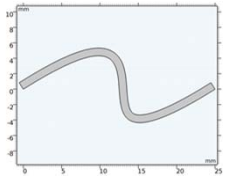
Optimized geometry

ISF toolpath design

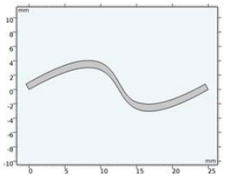


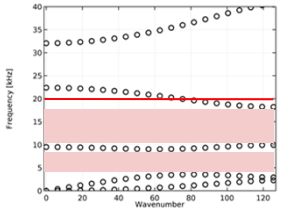
Results

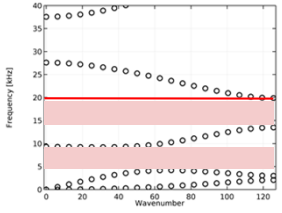
No ISF limits



With ISF limits

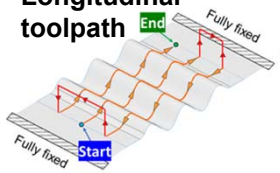


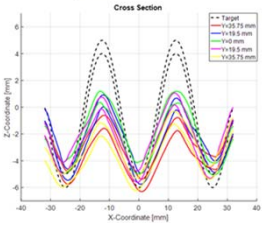




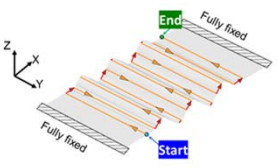
The optimized beam's transmission gap size is 14.6 kHz. By considering the ISF limits, the optimized gap size is **11.6 kHz** and the shape is manufacturable through ISF process.

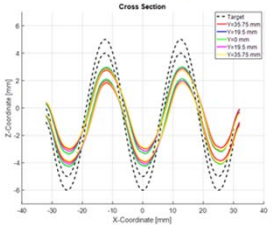
Longitudinal toolpath





Lateral toolpath





The lateral toolpath generates more uniform geometry comparing to the longitudinal toolpath.

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