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Materials Damping Research

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DRG materials damping research

viscoelastic
polymer master
curves

reinforced
polymer damping
elements

thin layers
and air film
damping

micro-
interface slip
damping

design of polymer
dampers and
isolators

adjustable
systems

1990

2000

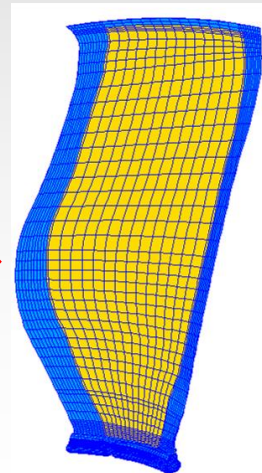
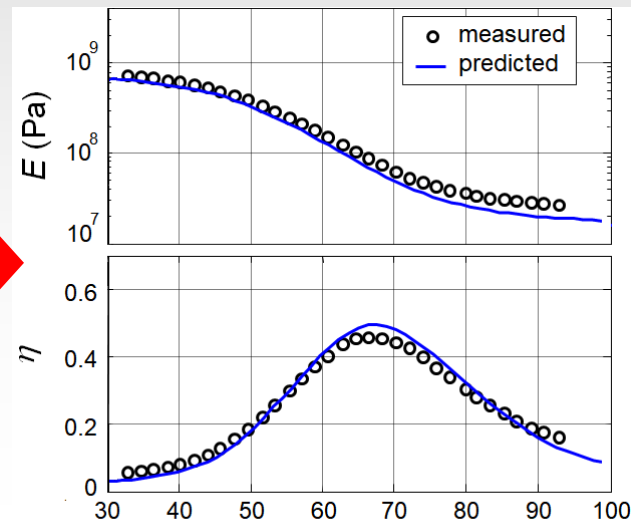
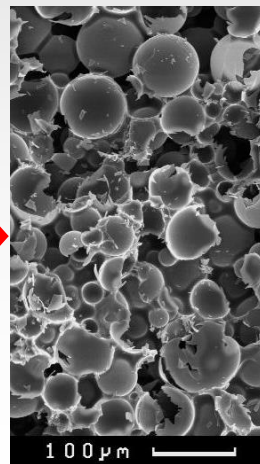
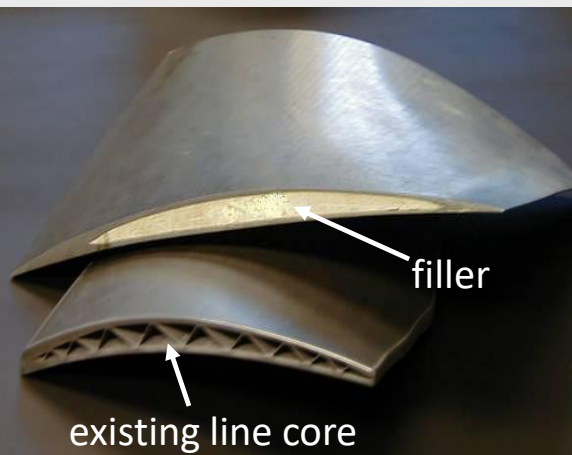
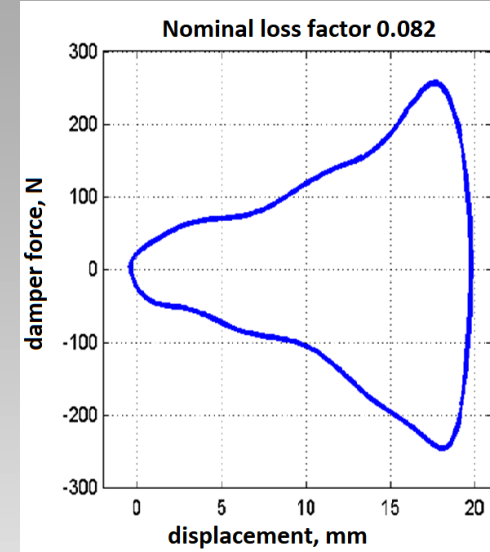
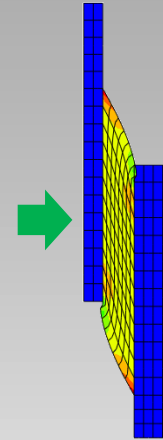
2010

2020



Reinforced polymers

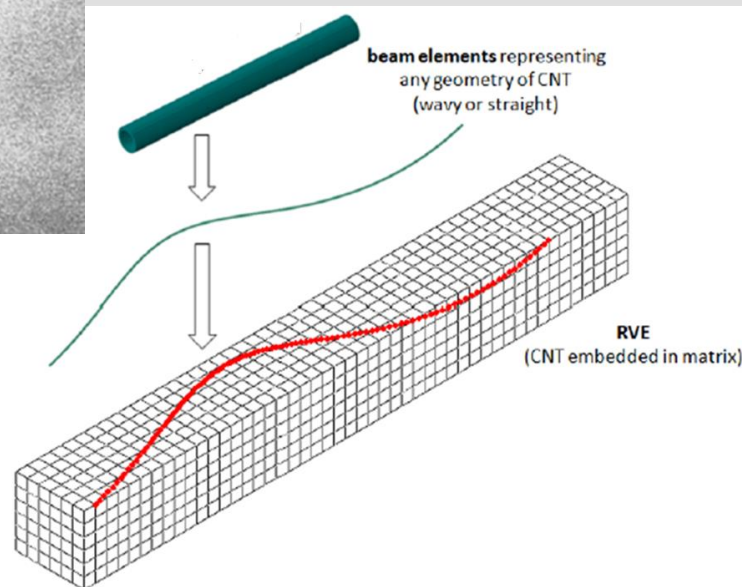
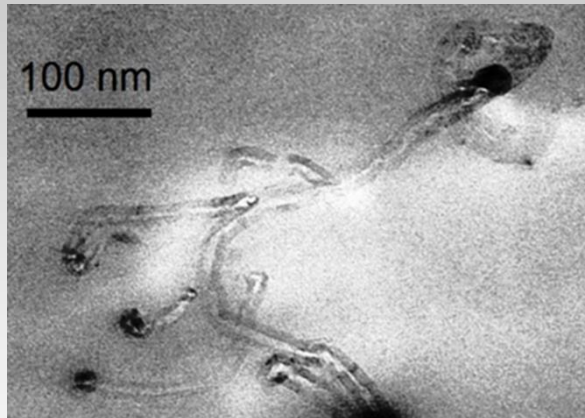
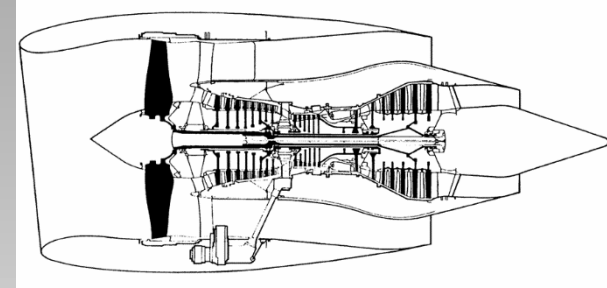
- Selection of polymer
 - Temperature range
 - Durability
 - Flow and adhesion
- Selection of reinforcement
 - Type
 - Loading and orientation
- Prediction and optimisation





Reinforced polymers 2

- Nanotube enhanced thermoplastic carbon fibre composite
 - Reduced creep and slightly increased damping
 - Design and build of representative aeroengine fan blade using multi-scale modelling



Apitiv film



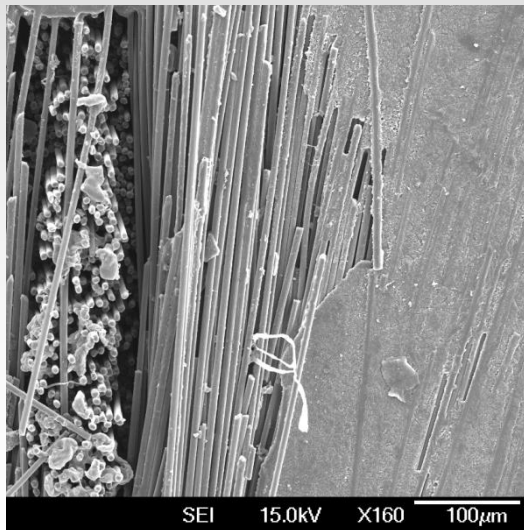
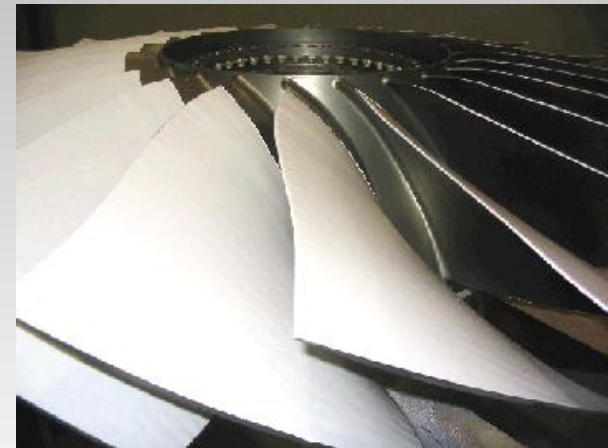
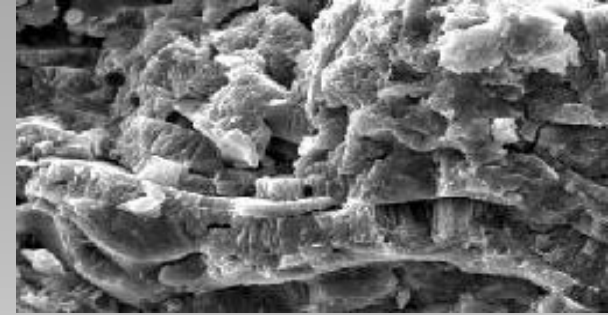
Nanotubes



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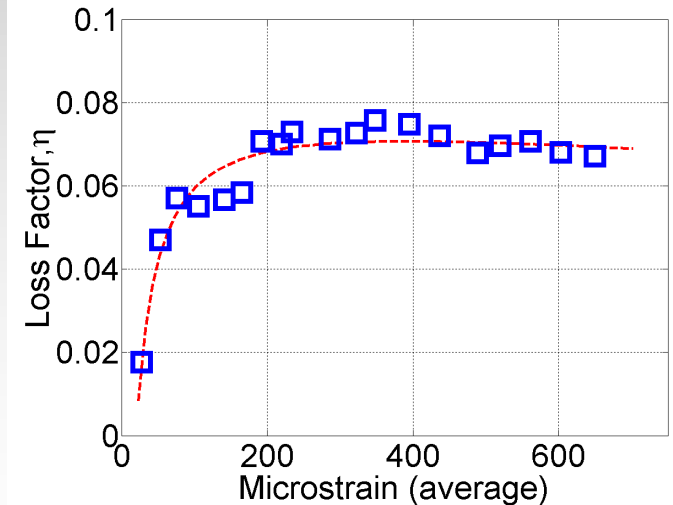
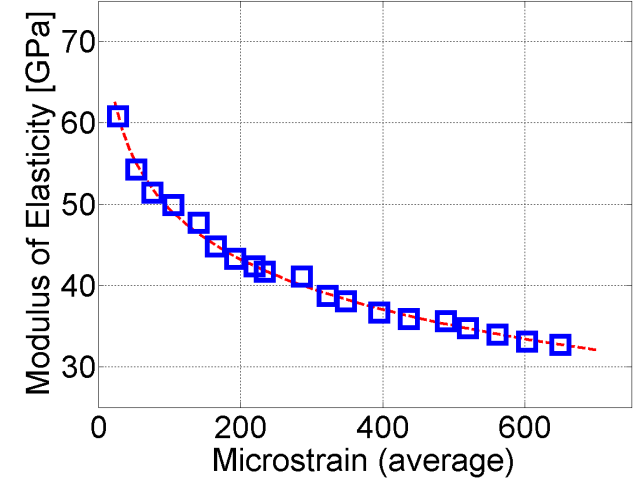
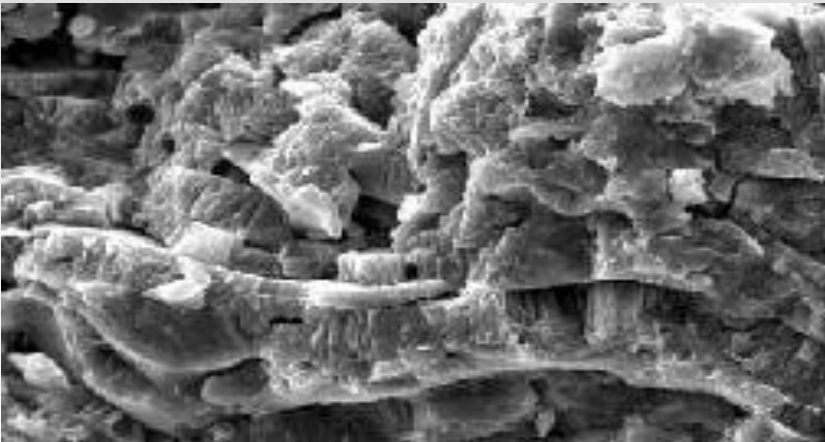
Micro-interface slip damping

- Can be obtained in many different ways
 - Thermally sprayed ceramic
 - Multi-strand fibres
 - Tangled wires
 - Granular systems
- Interesting and needed for applications requiring broad temperature range



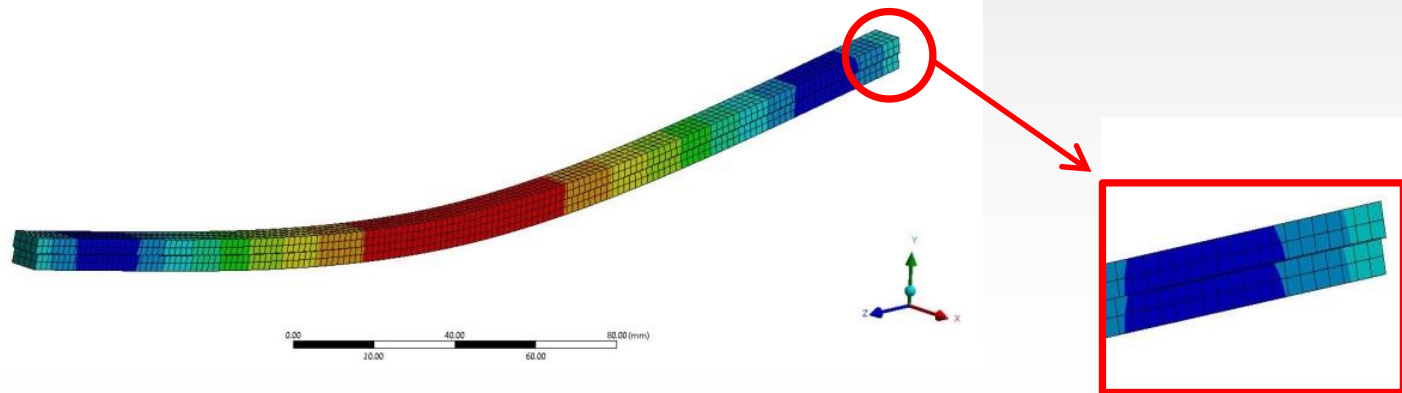
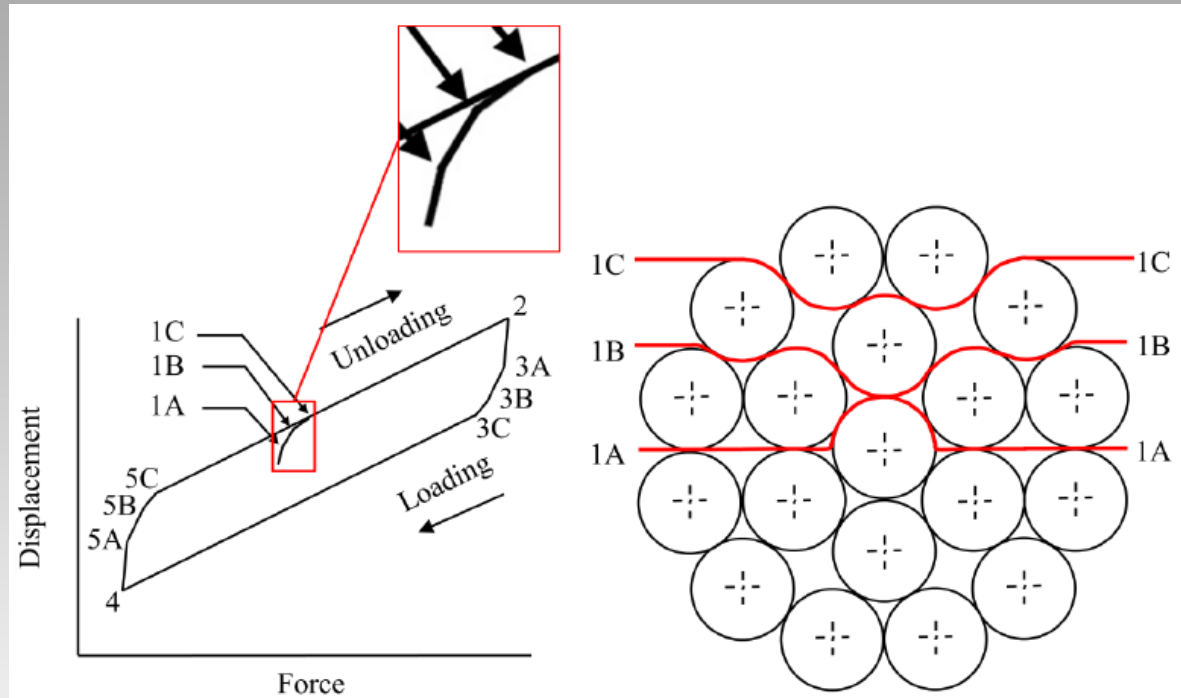
Micro-interface slip damping 2

- Thermally sprayed ceramic
 - Line of sight process
 - Layered microstructure provides interfaces for friction
 - Nonlinear properties
- High performance as a free-layer coating



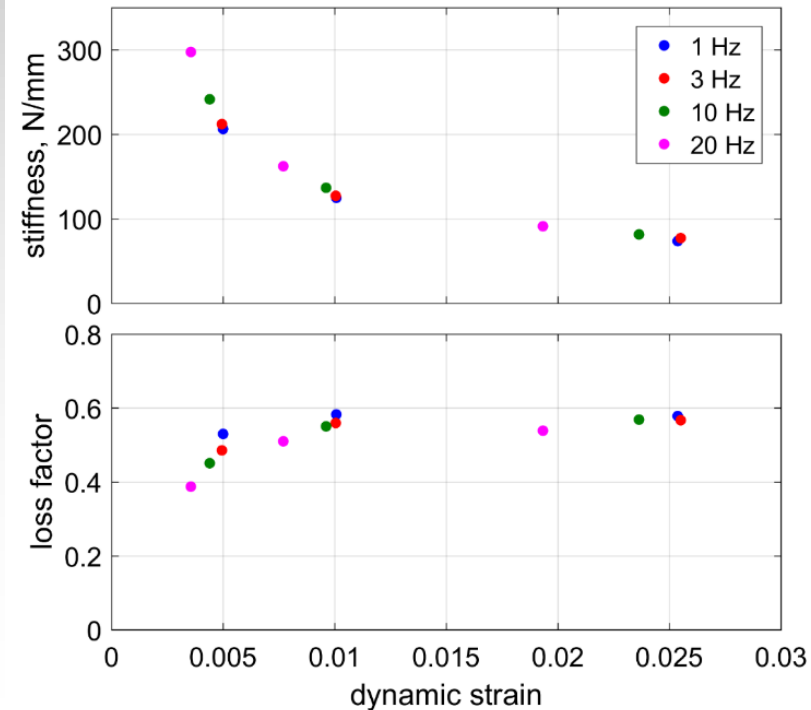
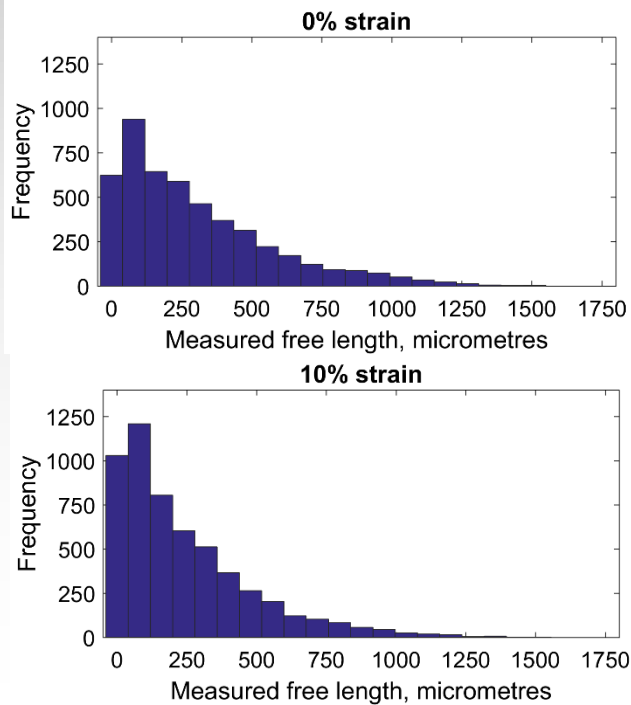
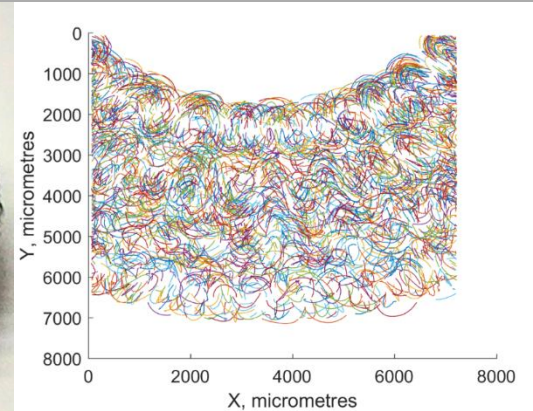
Micro-interface slip damping 3

- Structures built from rods, wires or strands
 - Energy dissipated by friction at interfaces
 - Simplified analytical models
 - Many strands smooth classical friction-dominated hysteresis loop



Micro-interface slip damping 4

- Tangled metal wire
 - Vibration properties similar to natural rubber
 - Microstructure identified using x-ray tomography
 - Information for modelling

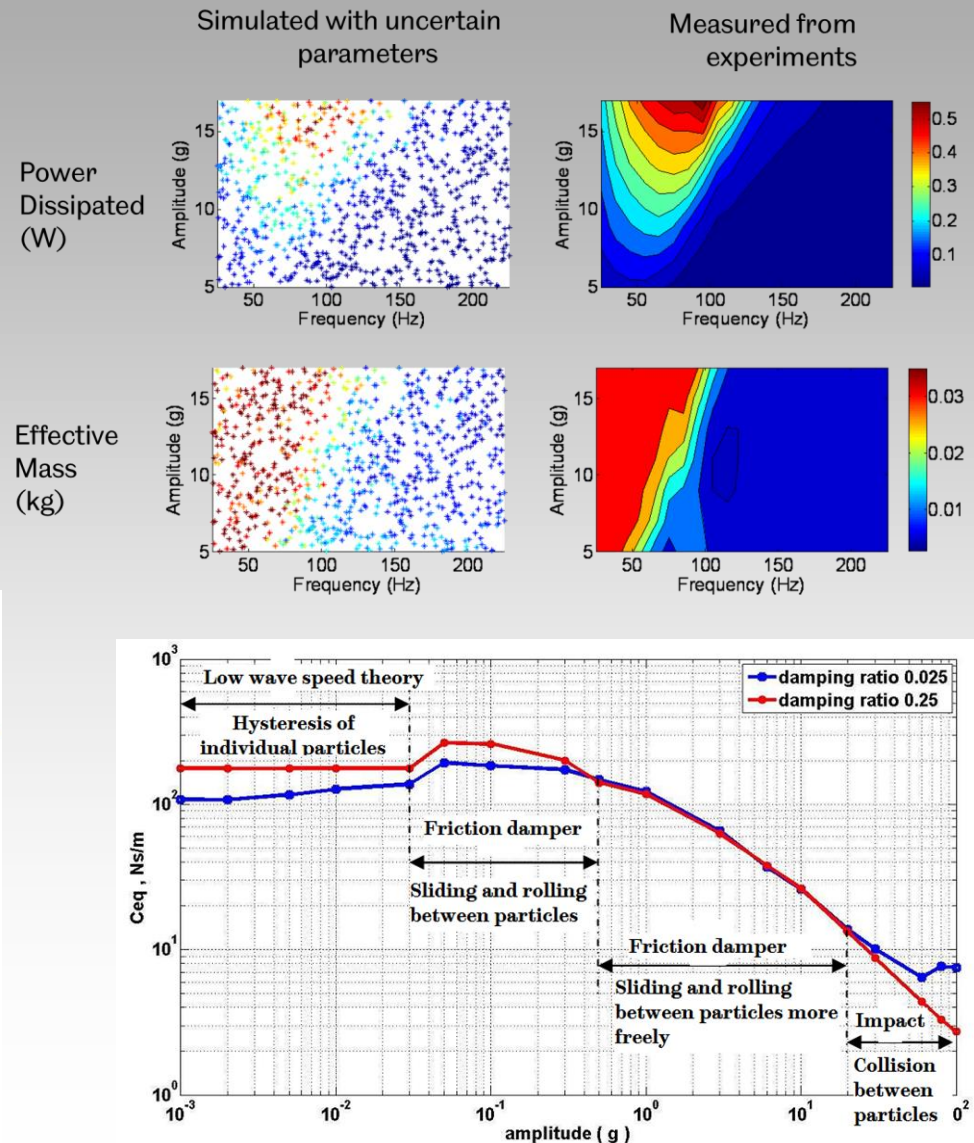
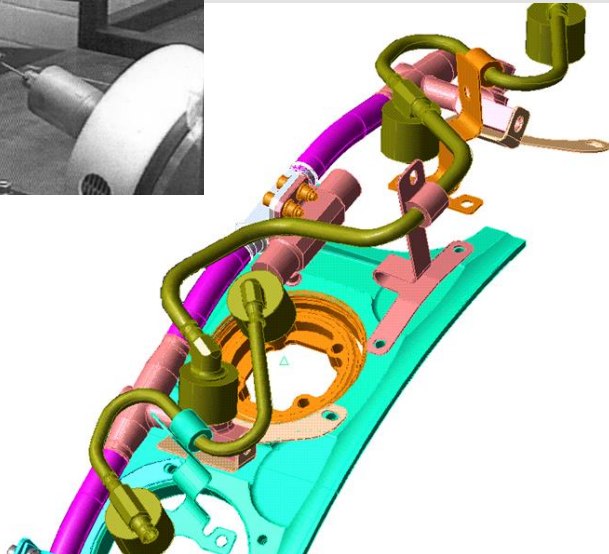
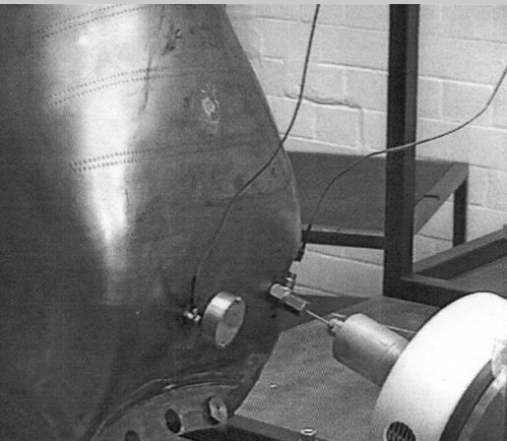




Micro-interface slip damping 5

- Granular systems

- Particle dampers
- Fragmented materials
- Different phases under vibration



Adjustable systems

- Active systems
 - PZT-enhanced active CLD
- Semiactive systems
 - Adjustable TMD
 - Adjustable particle dampers

