Materials Damping Research

Jem Rongong
j.a.rongong@sheffield.ac.uk
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
• Nanotube enhanced thermoplastic carbon fibre composite
  - Reduced creep and slightly increased damping
  - Design and build of representative aeroengine fan blade using multi-scale modelling
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
- 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

![Graphs showing frequency distribution and stiffness-loss factor relationship](image-url)
- **Granular systems**
  - Particle dampers
  - Fragmented materials
  - Different phases under vibration

Simulated with uncertain parameters vs. Measured from experiments

- Power Dissipated (W)
- Effective Mass (kg)

Low wave speed theory vs. Hysteresis of individual particles

- Friction damper
- Sliding and rolling between particles
- Impact between particles
Adjustable systems

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