Modelling of damping in small satellite structures incorporating bolted joints

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Modelling of Damping in Small Satellite Structures Incorporating Bolted Joints

- **Background**
- Estimating energy dissipation in plain bolted joints of a satellite structure
- Estimating energy dissipation in viscoelastic layered bolted joints of a satellite structure
- Nonlinear behaviour of viscoelastic layered bolted joints

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ProE model of the GSTB-v2/A satellite

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Estimating energy dissipation in plain bolted joints of a satellite structure

Detailed bolted joint model

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Estimating energy dissipation in plain bolted joints of a satellite structure

Finite element model of the satellite

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Estimating energy dissipation in plain bolted joints of a satellite structure

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Percentage of energy dissipated from joints to input energy

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Estimating energy dissipation in viscoelastic layered bolted joints of a satellite structure

Typical properties of a viscoelastic material

\[ G^* = (1 + i\eta)G \]

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Simple model of viscoelastic material

\[ \frac{F}{A} = (1 + i\eta)G \frac{x}{h} \]

Detailed Bolted Joint with Viscoelastic Layer

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$F = \frac{AG}{h}$

$c = \frac{AG\eta}{h\omega}$

Kelvin or Voigt Model

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Simple satellite model

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Energy input to the satellite \( (J) \)

Structure damping coefficient

Energy changing with structural damping coefficient in different satellite models

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<table>
<thead>
<tr>
<th>Structural damping coefficient</th>
<th>0.02</th>
<th>0.04</th>
<th>0.06</th>
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<tr>
<td>Energy percentage</td>
<td>34%</td>
<td>20%</td>
<td>14%</td>
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The percentage of energy dissipated in the viscoelastic layer to the input energy

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Nonlinear behaviour of viscoelastic layered bolted joints

A film of Cho-Therm T500

VersaSil used in the bolted joints

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Nonlinear behaviour of viscoelastic layered bolted joints

Comparison of experimental data and data from the optimised spring dashpot system for VersaSil

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Investigation of energy dissipating capability of bolted joints (ongoing)
No existing models for this scale of problem
Experiments
  - Numerical fit to spring dashpot system
  - With good correlation
Preliminary results
  - FE analysis very promising
  - In analysis and test appears well suited to damping structures
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