



Stiffness measurement of viscoelastic materials against frequency using a piezoelectric actuator

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Surveillance 8

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Background

- ① Study of the effects of viscoelastic materials (shims) on dynamic instabilities leading to squeal noise in brake systems.
- ② Silicon characterization in the MAIAS project.
- ③ Shape-memory polymer characterization.

Specifications

- ① Uniform static preload.
- ② Dynamic compression/shear excitation, $f \in [0, 1..10]\text{kHz}$.
- ③ Samples strain and stress measurement.
- ④ Avoiding vibrations noise disturbing the material characterization.

Overview :

1 Some ideas for the specifications

2 4 samples shear viscoanalyser

Architecture and design optimisation

Post-treatment

Some results

3 Monoaxial viscoanalyser

New specifications

Results

4 Conclusion and perspectives

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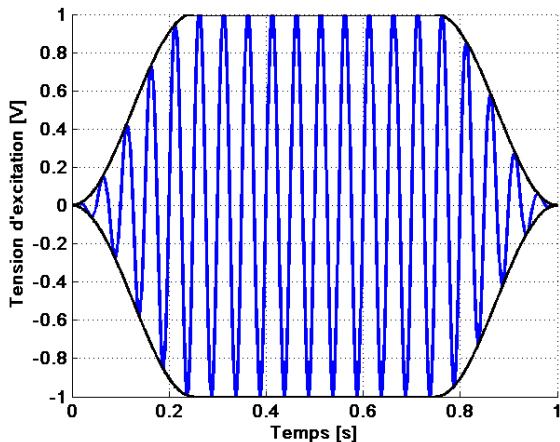
Results

4 Conclusion and perspectives

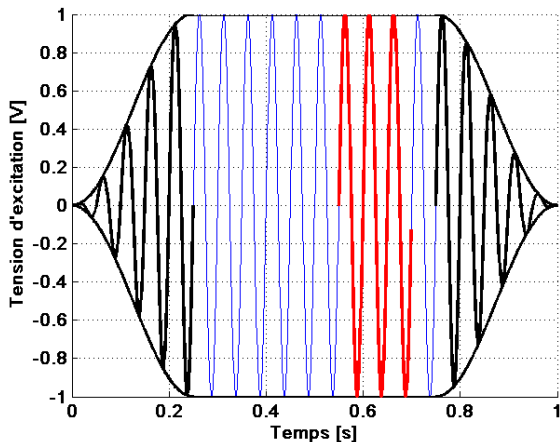
Some ideas for the specifications

- ① Use of piezoelectric actuators for excitation up to 10kHz.
- ② Quasi-static use of the viscoanalyser, at frequencies below the first eigenmode of the system.
- ③ Design of ultra compact viscoanalyser to increase the frequency of the first eigenmode.
- ④ Short time duration of excitation signal to avoid the material warming up.
- ⑤ Monochromatic excitation signal to limit transient effects.
- ⑥ Step by step sweep of the frequency bandwidth.
- ⑦ Choosing excitation frequency such as there are an integer number of time samples per cycle.

Chosen excitation signal



Chosen excitation signal



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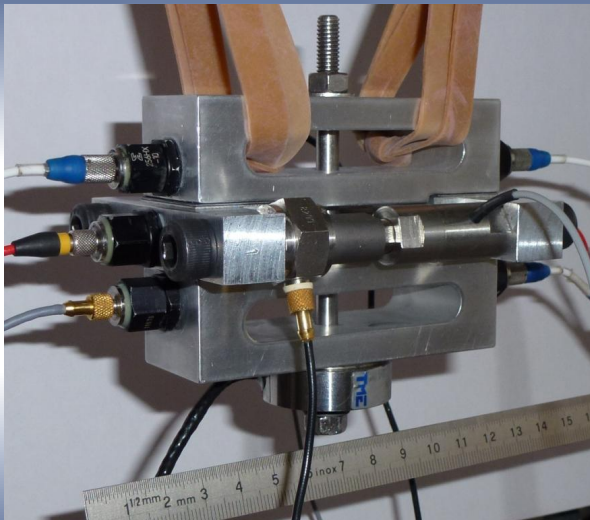
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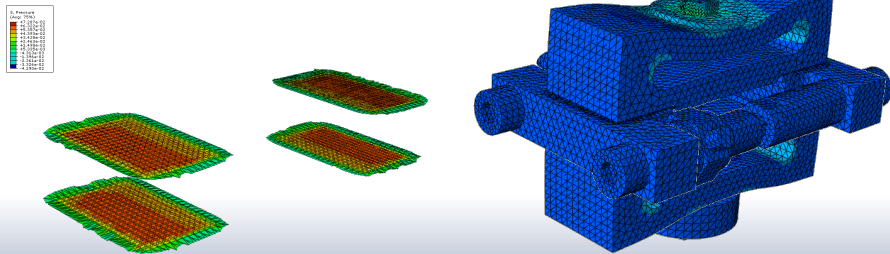
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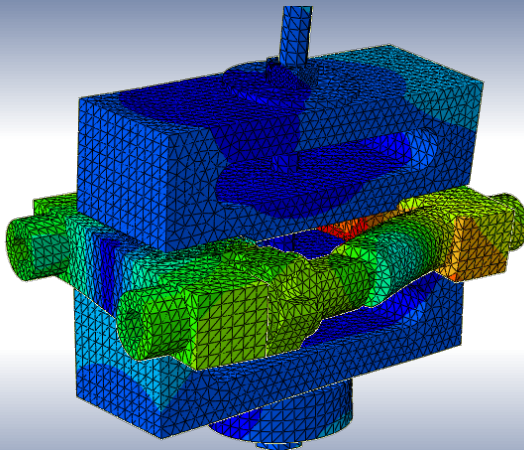
Shear viscoanalyser



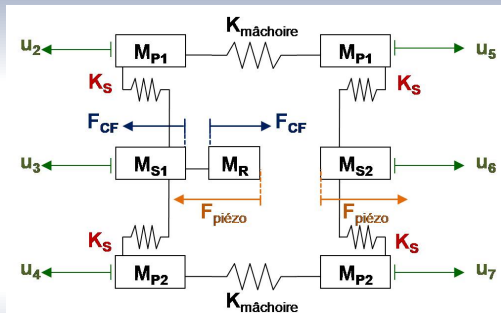
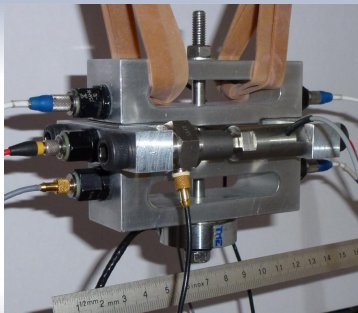
Uniform preload



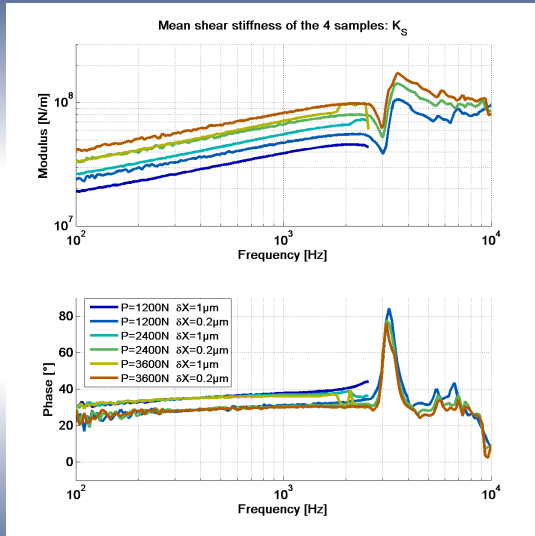
Disturbing eigenmode about 3500Hz



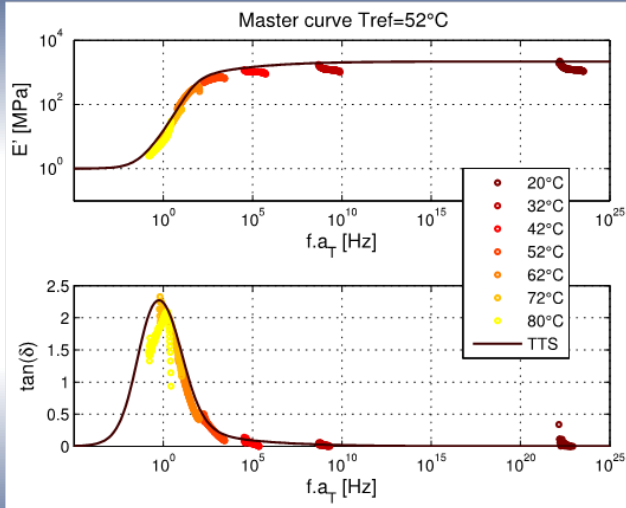
Post-treatment



Results of a shim characterisation



Results for a shape-memory polymer



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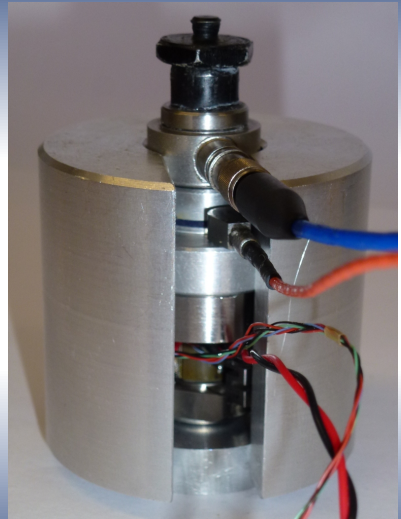
Specifications

- ① Apply and measure a static preload.
- ② Shear/compression excitation [1 - 10] kHz.
- ③ Measure samples strain and stress.
- ④ Avoid disturbing eigenmodes.

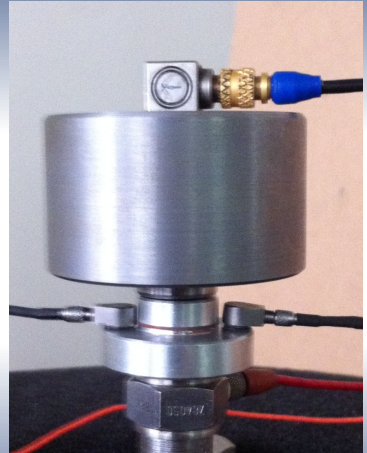
Compression sample

Shear sample

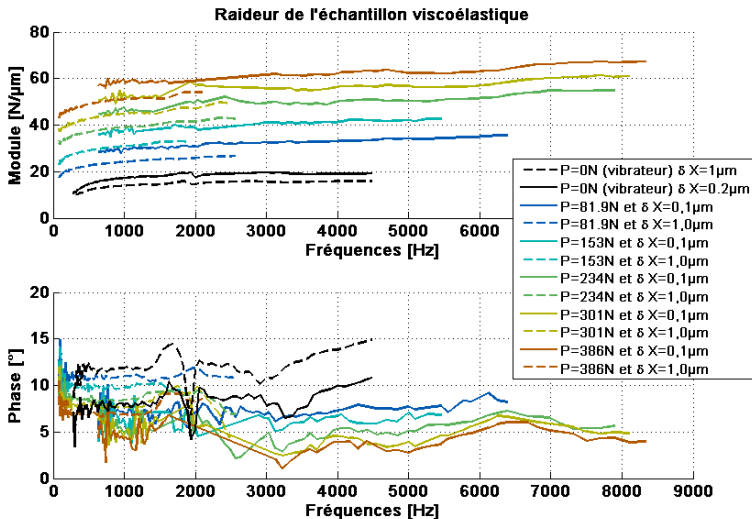
Monoaxial viscoanalyser



Validation test with a shaker and no preload



Results



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Conclusion and perspectives

Objectives

- Characterization without using time-temperature equivalence.
- The 4 samples viscoanalyser allows shim characterization in squeal noise conditions !
- The monoaxial viscoanalyser allows characterization of silicons up to 8kHz.

Perspectives

Improve tests protocol to facilitate the use of these viscoanalyser.