



Status report
on active stabilisation
of a linear collider final focus quadrupole mock-up

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Laboratories in Annecy working on Vibration Stabilisation

Catherine ADLOFF (20%)

Benoît BOLZON (100%)

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Laurent BRUNETTI (100%)

Fabien FORMOSA (10%)

Jacques LOTTIN (20%)

Laurent GIACOBONE

Claude GIRARD

Fabrice PELTIER

Yan BASTIAN

Franck CADOUX



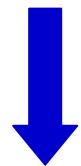
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Final focus system vibrations

Excitation spectrum



Structural resonances

(Amplified motions)

{ **Ground motion**
Cooling system
Air flows
Power supply system...



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Outlines

1. Measurements

- Sensor characteristics
- Ground motion
- Acquisition tools

2. Modelling & Simulation

- Tools
- Tests
- Comparison

3. Feedback loop

- Reduced size Mock up
- Algorithm
- Results

4. Future prospects

- New Mock up design
- Simulation of the whole system



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Measurements

2 types of sensors :

→ **Seismic sensors** : Measurement of the ground velocity

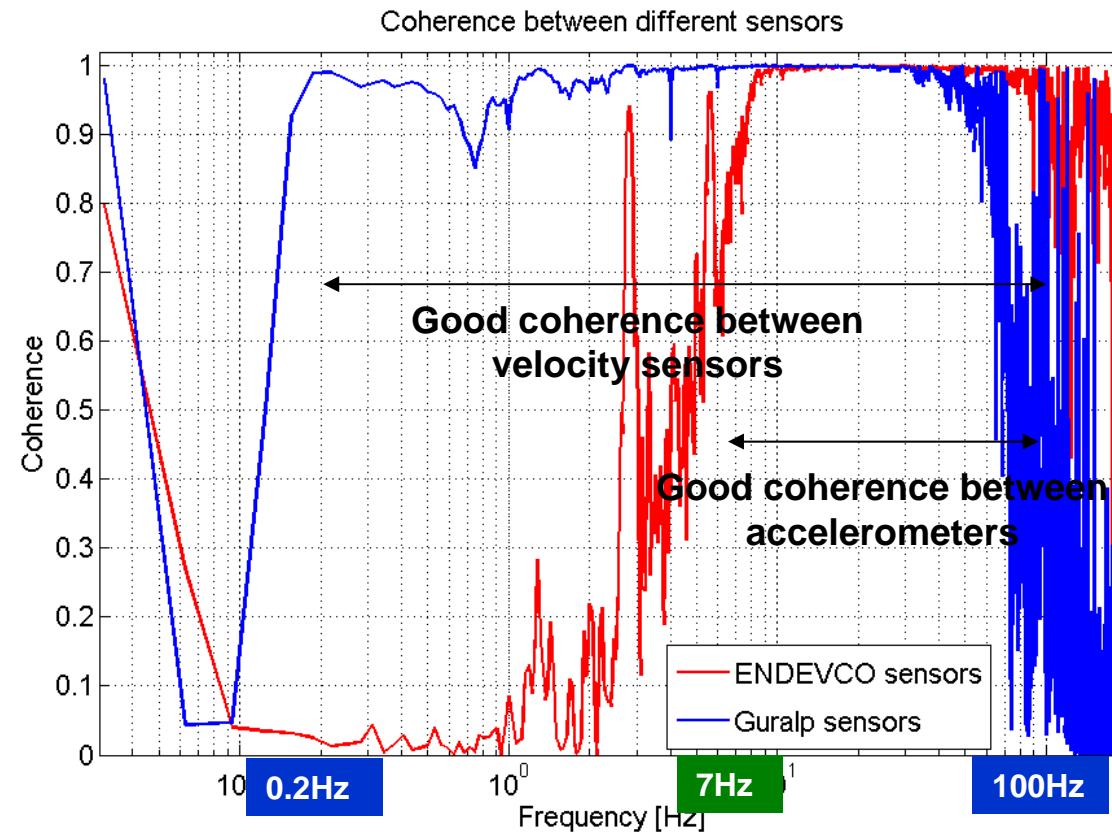
→ **Accelerometers** : Measurement of the ground acceleration

Sensors	VE-13	Guralp CMG-40T	SP400U	GSV-320	ENDEVCO 86
Sensitivity	1V → 1 mm/s	1V → 0.625mm/s	1V → 1 mm/s	1V → 0.5 mm/s	1V → 0.1g
Guaranteed frequency range	1 - 315 Hz	0,033 - 50 Hz	0,1-50 Hz	1 - 315 Hz	1-100 Hz
Quantity	2	2	2	2	2





Measurements



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- **Home made DAQ based on PXI-4472B ADC from NI**
 - ✓ ADC designed for spectral analysis : includes anti-aliasing...
 - ✓ Labview software for data acquisition (our development)
 - ✓ VE13, Guralp, SP400, GSV320, ENDEVCO sensors

- **Bruel and Kjaer electronics**
 - ✓ ADC also designed for spectral analysis, especially for modal analysis
 - ✓ Pulse software for data acquisition (from the company)
 - ✓ VE13, Guralp, SP400, GSV320, ENDEVCO sensors
 - ✓ Less electronic noise and better resolution
 - Better results with accelerometers at low frequencies (same results with velocity sensors which have a bigger amplitude)
 - This system has been used to show the current results



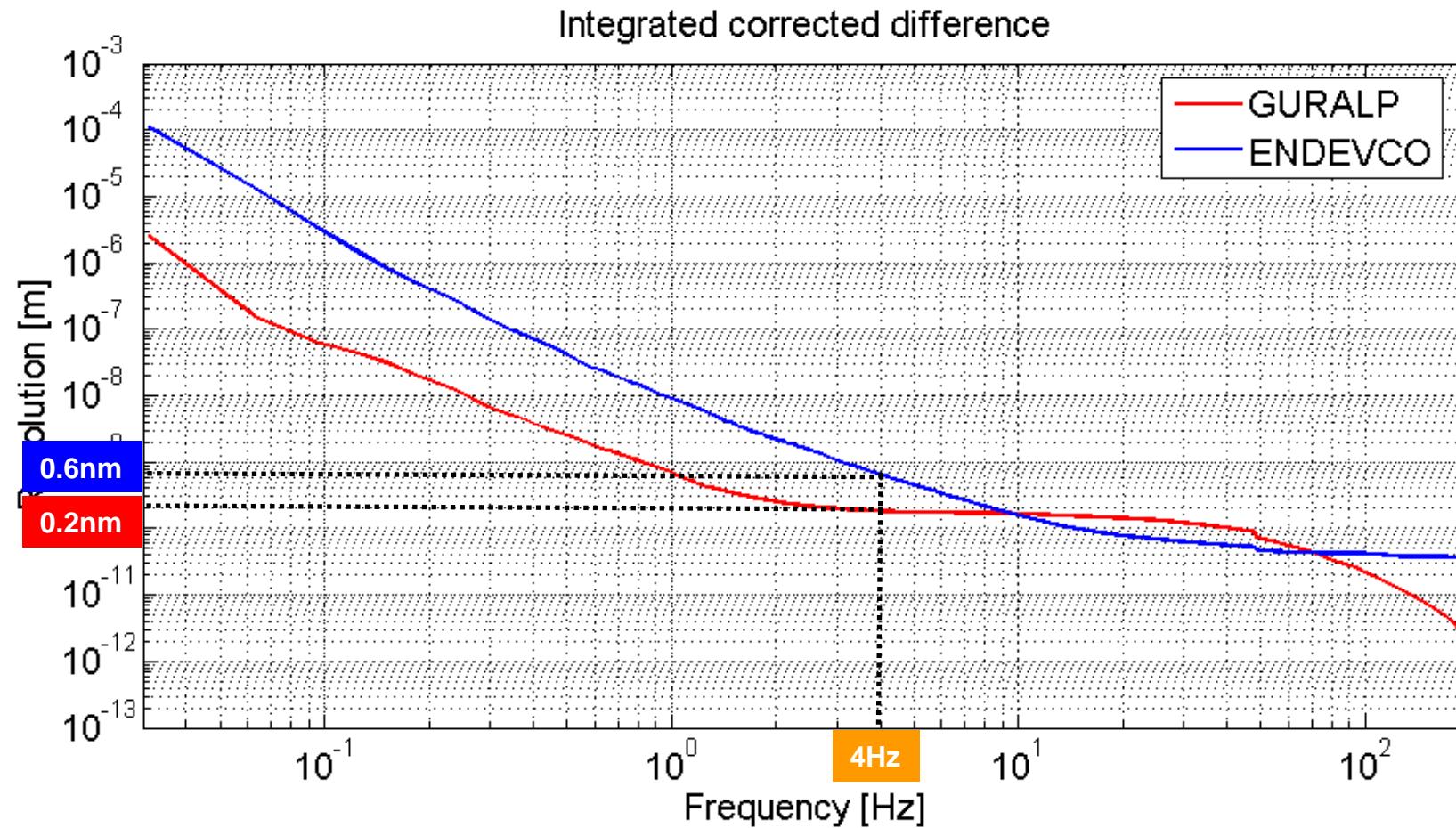
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Measurements

Resolution



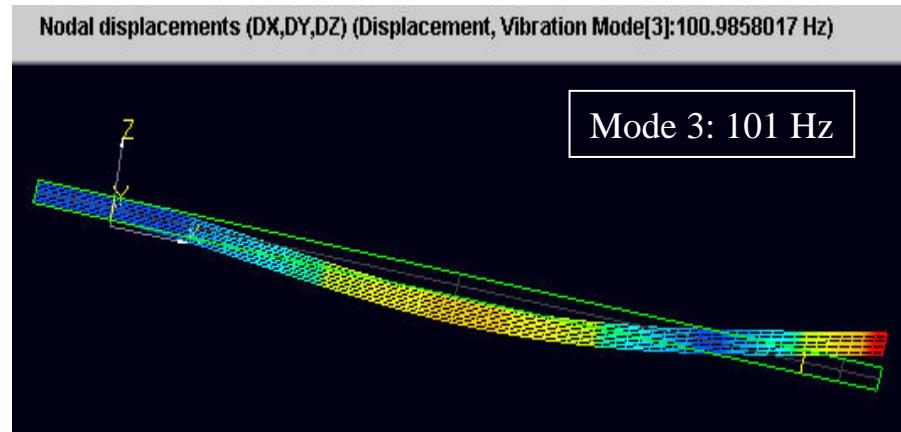
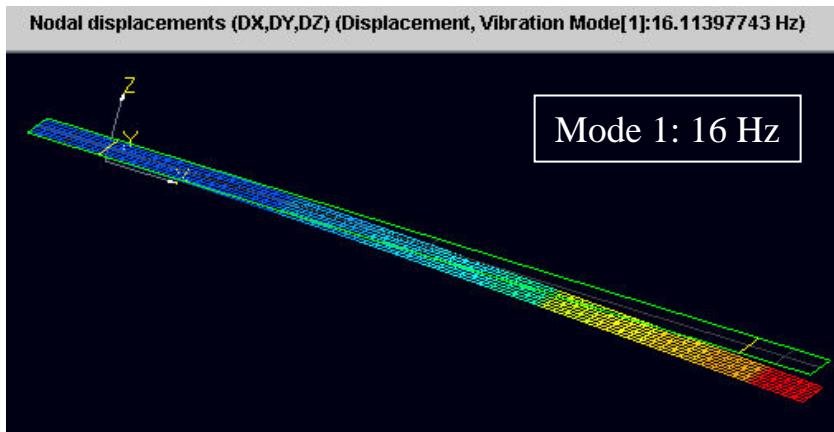
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Modelling & Simulation

- SAMCEF -



Modal tests on the free-fixed beam

- Identify eigenfrequencies
- Display mode shapes



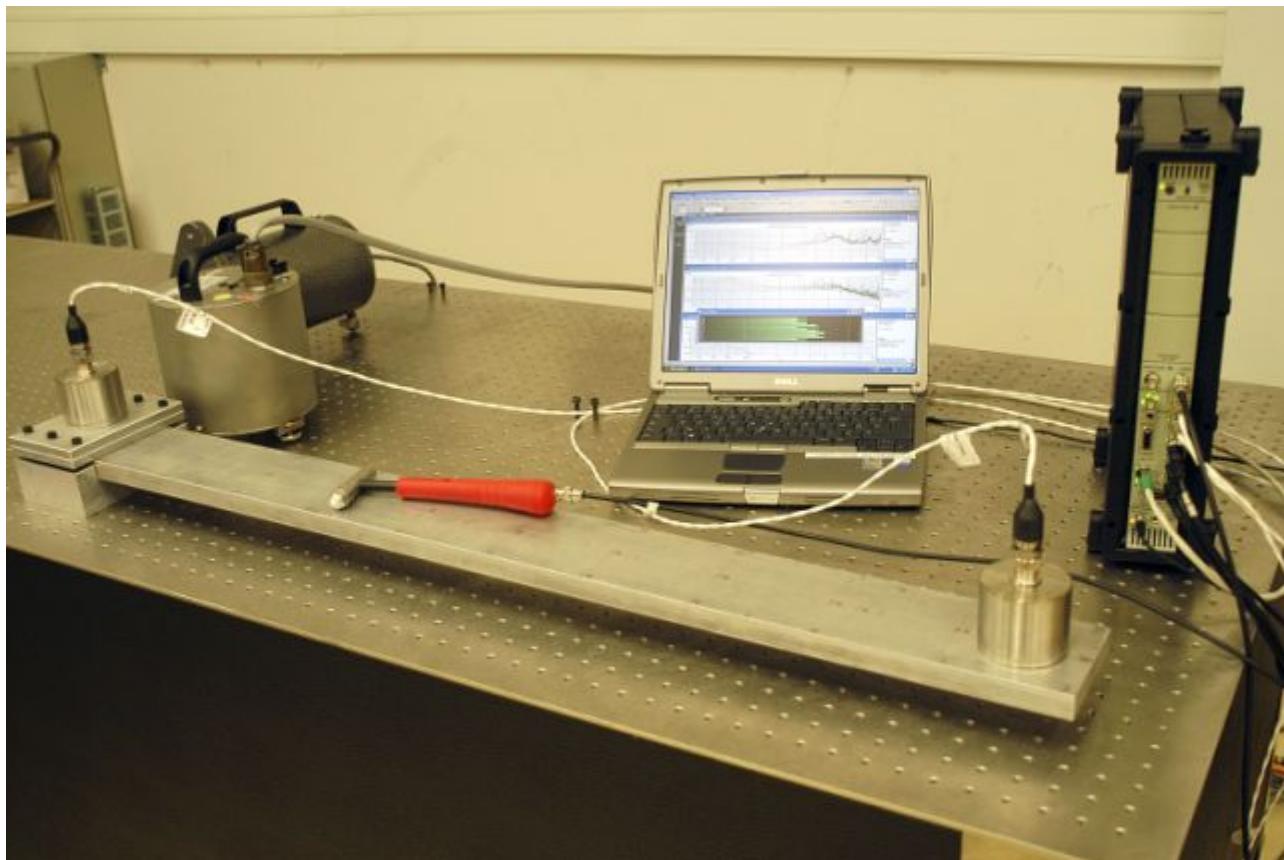
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Modelling & Simulation

Experimental set-up



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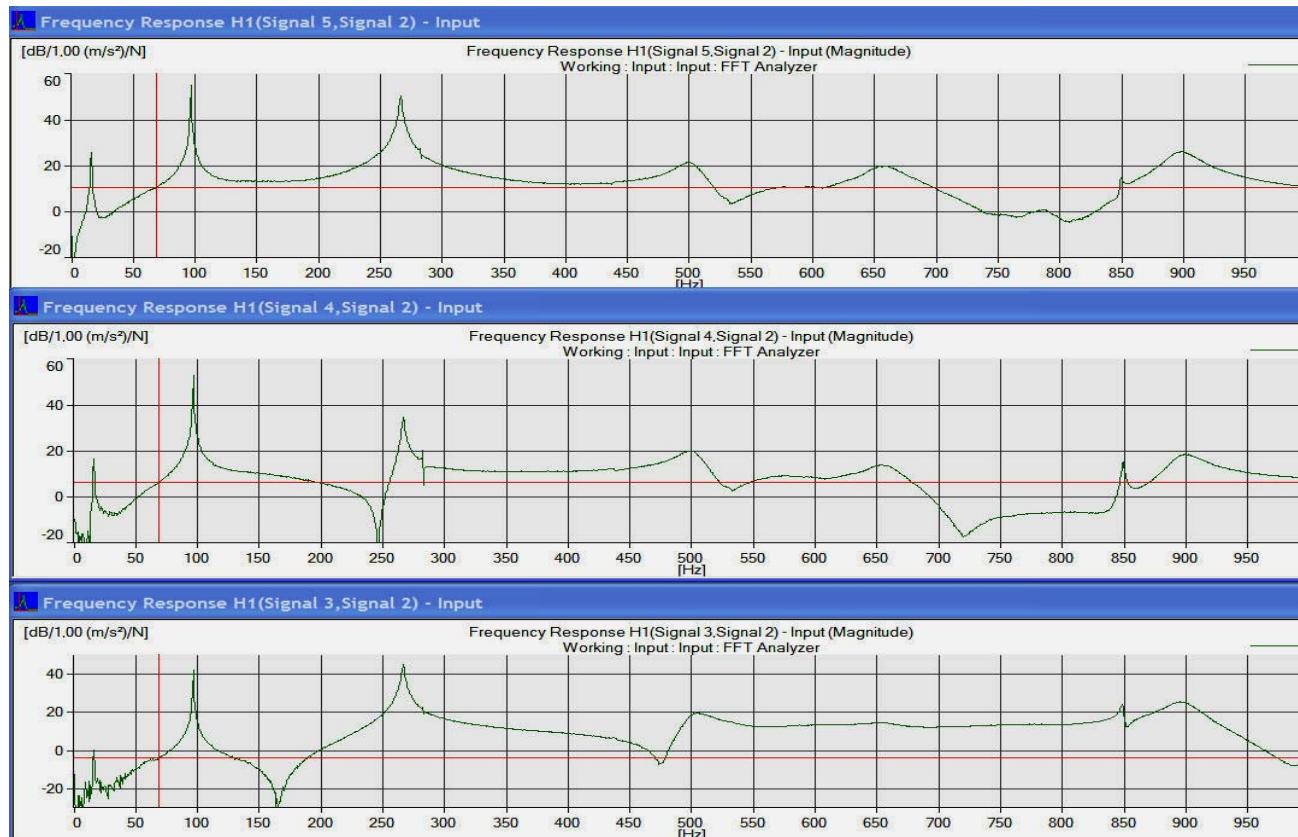




Modelling & Simulation

- PULSE**

FFT Analysis



$$f_1 = 16 \text{ Hz}$$

$$f_2 = 72 \text{ Hz}$$

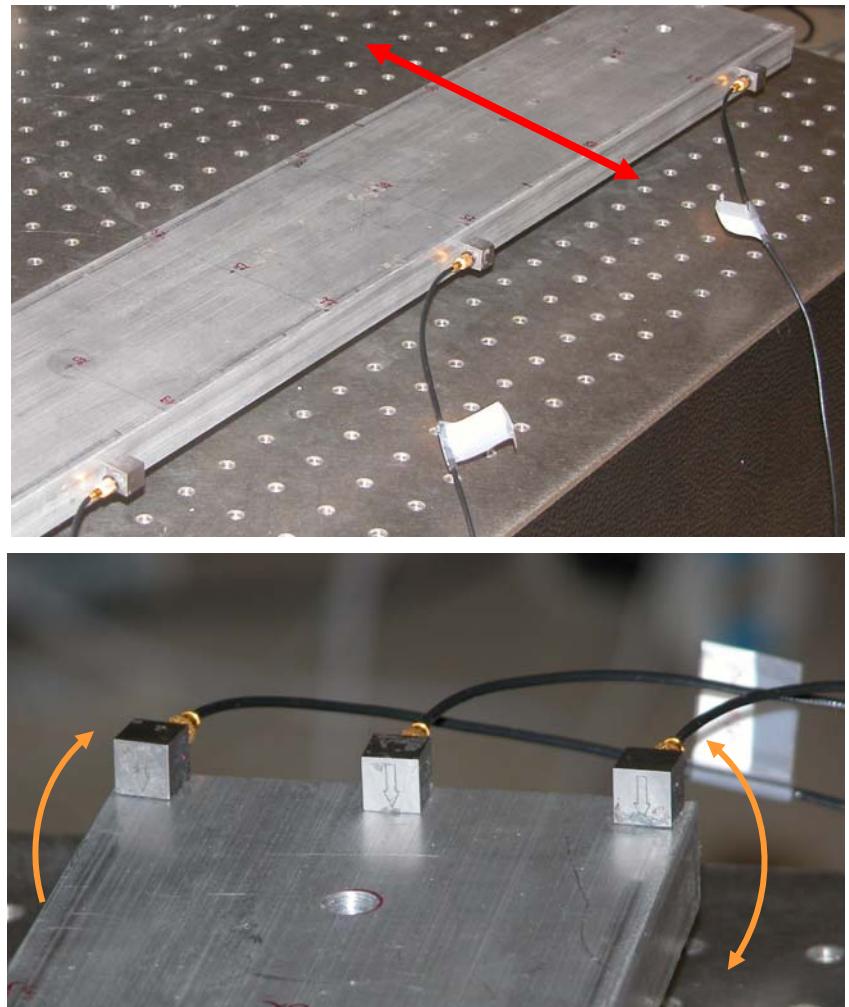
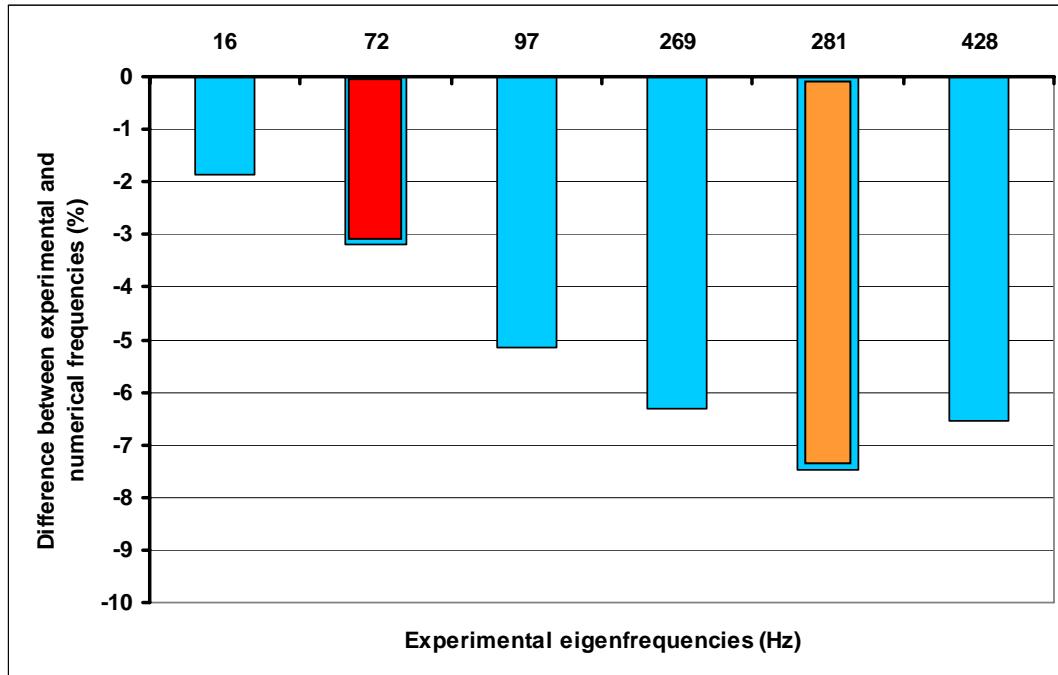
$$f_3 = 97 \text{ Hz}$$

$$f_4 = 269 \text{ Hz}$$

$$f_5 = 281 \text{ Hz}$$

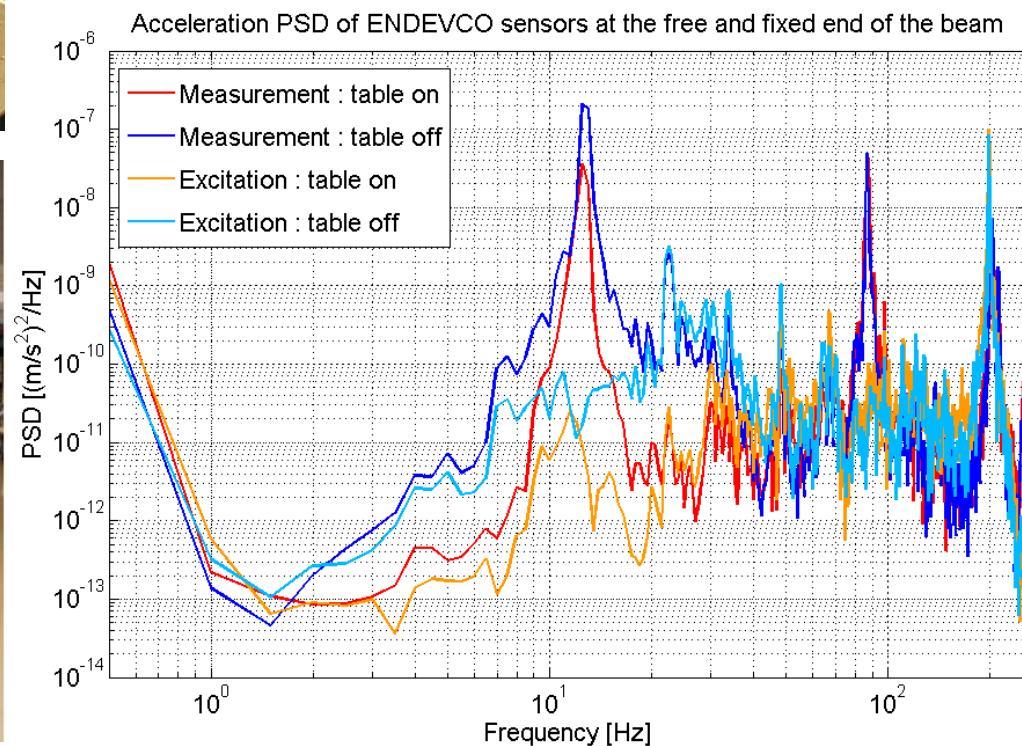
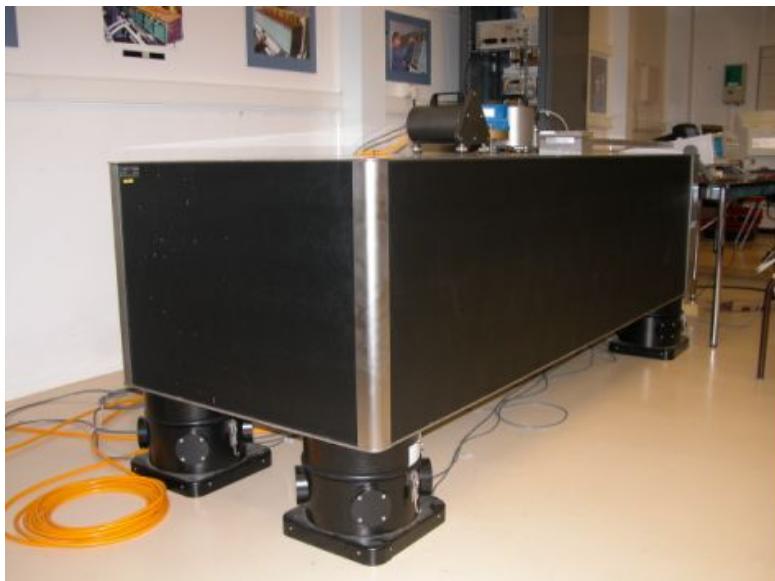
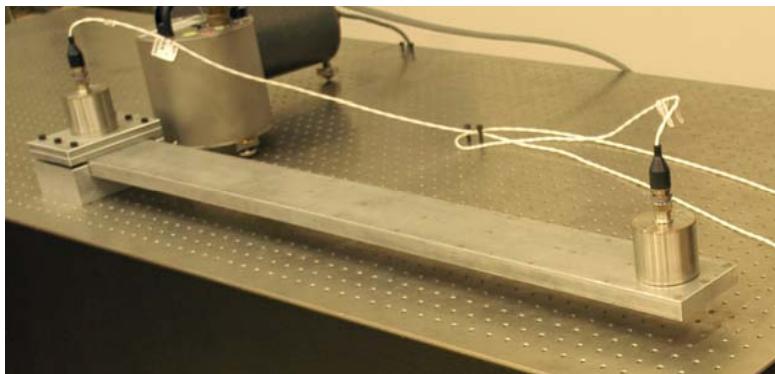


Modelling & Simulation





Modelling & Simulation

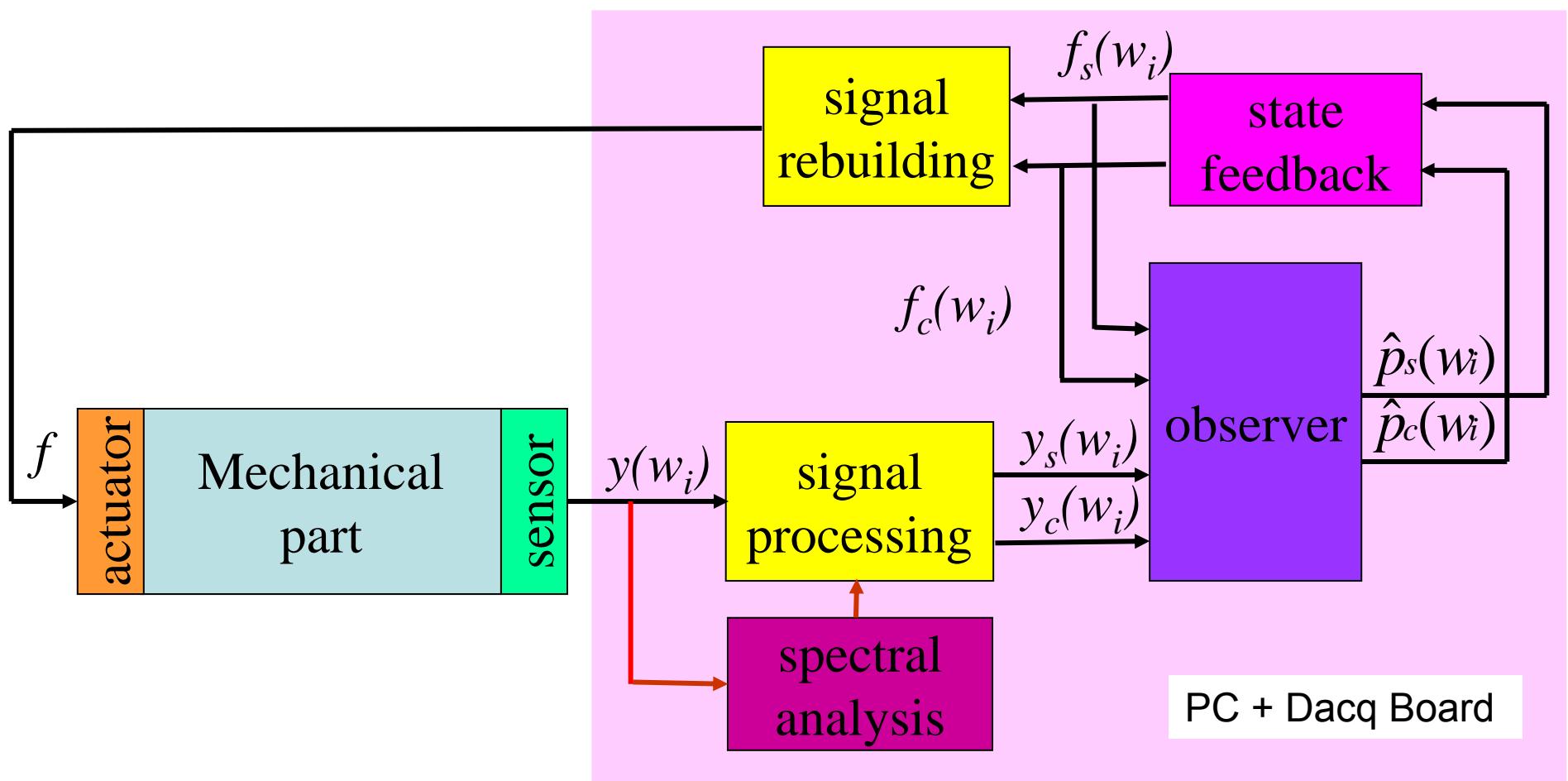


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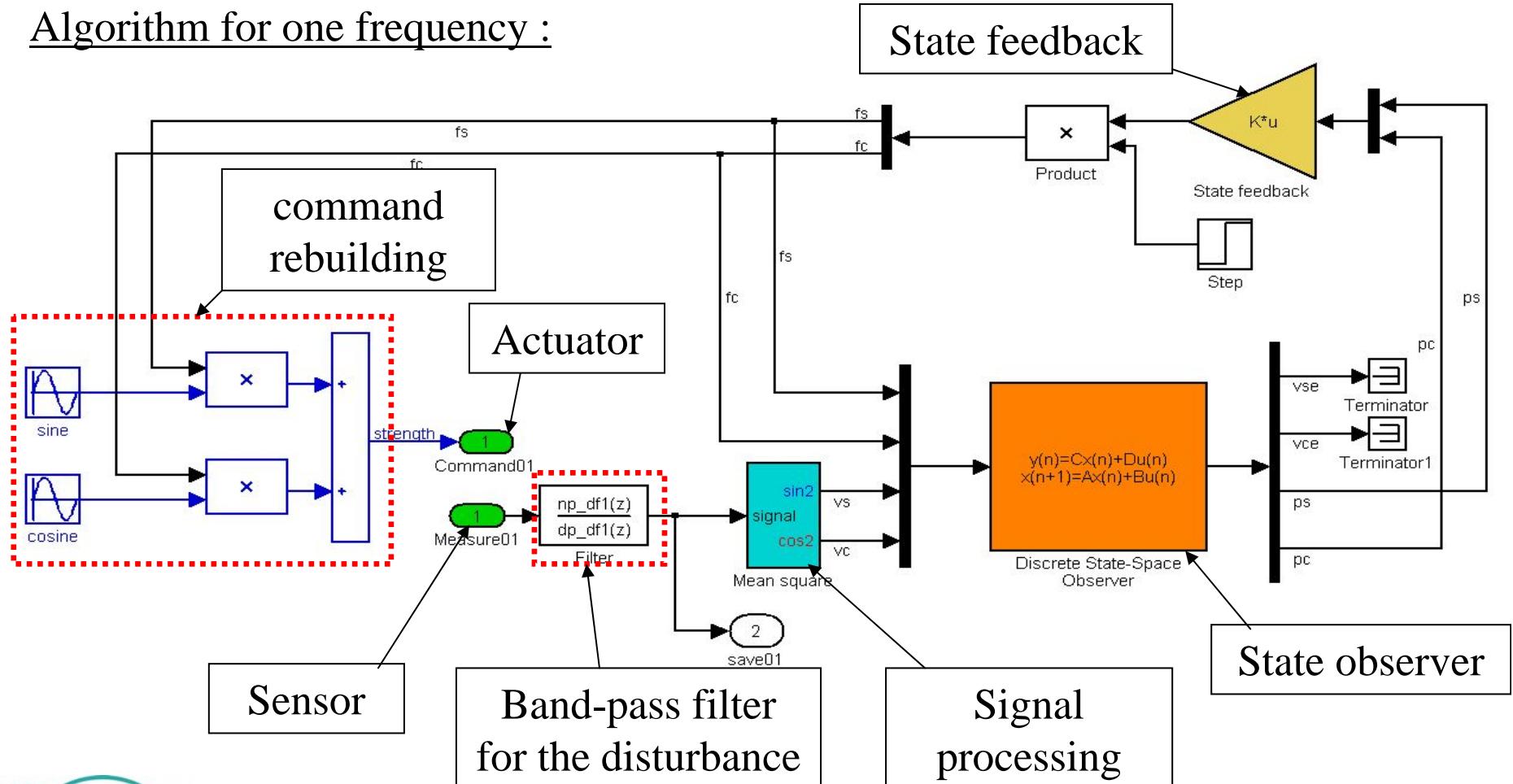
Active rejection





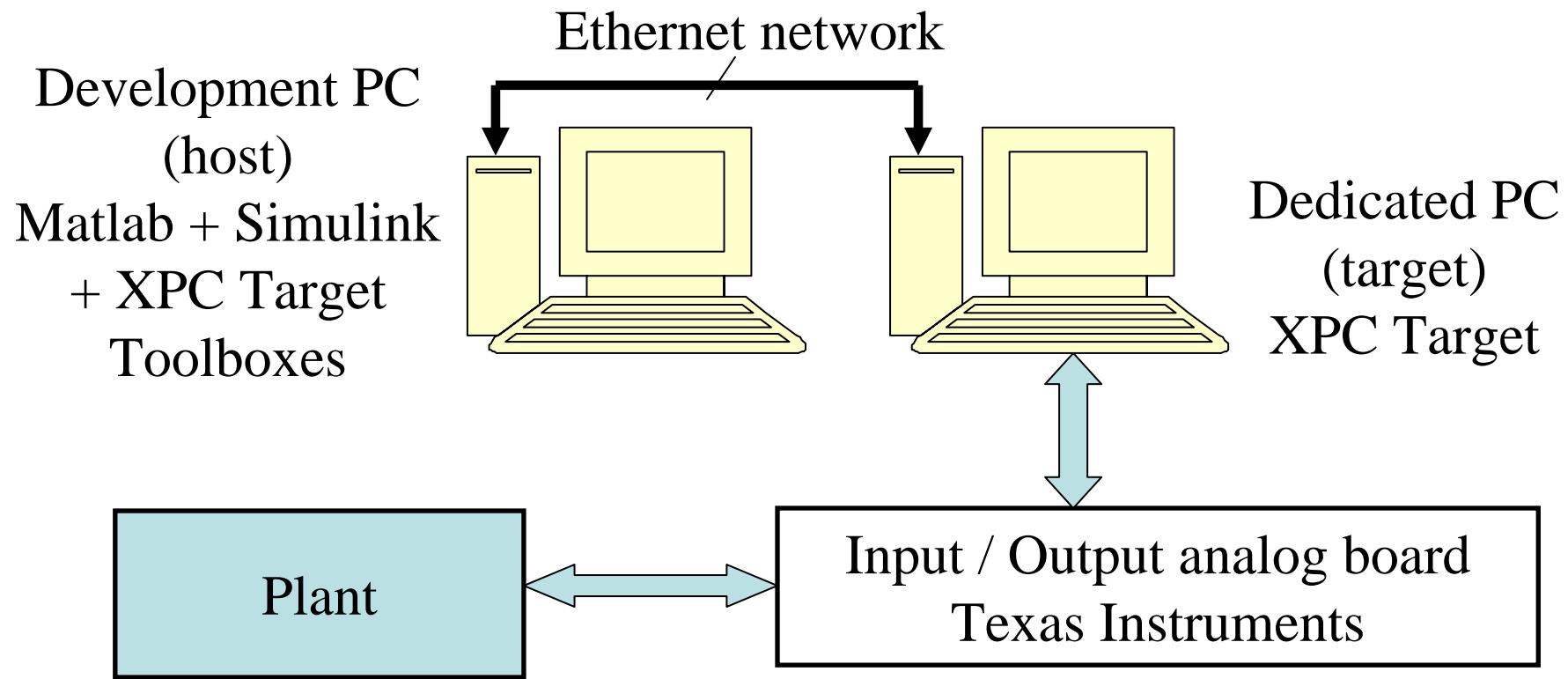
Active rejection

Algorithm for one frequency :



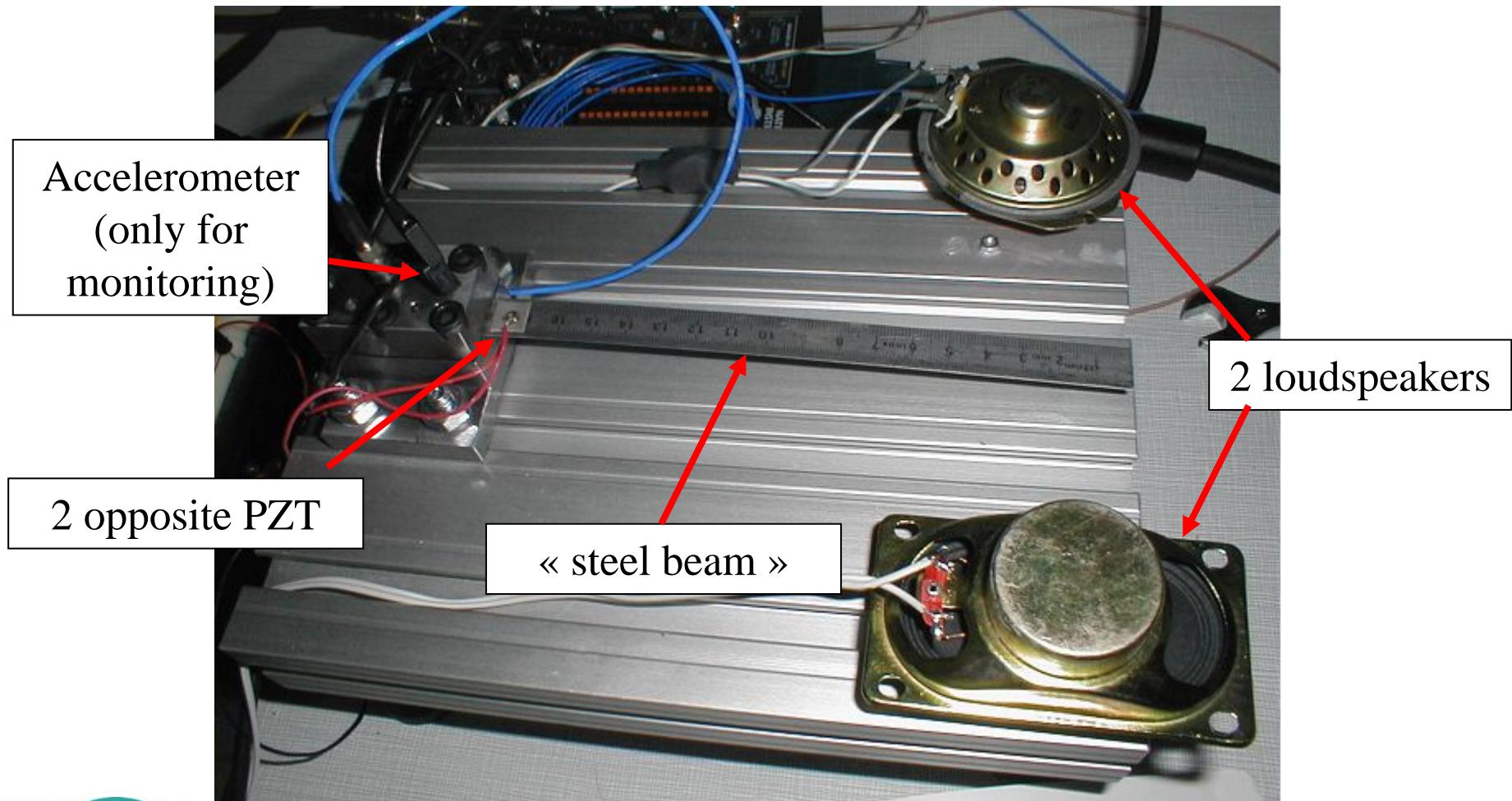


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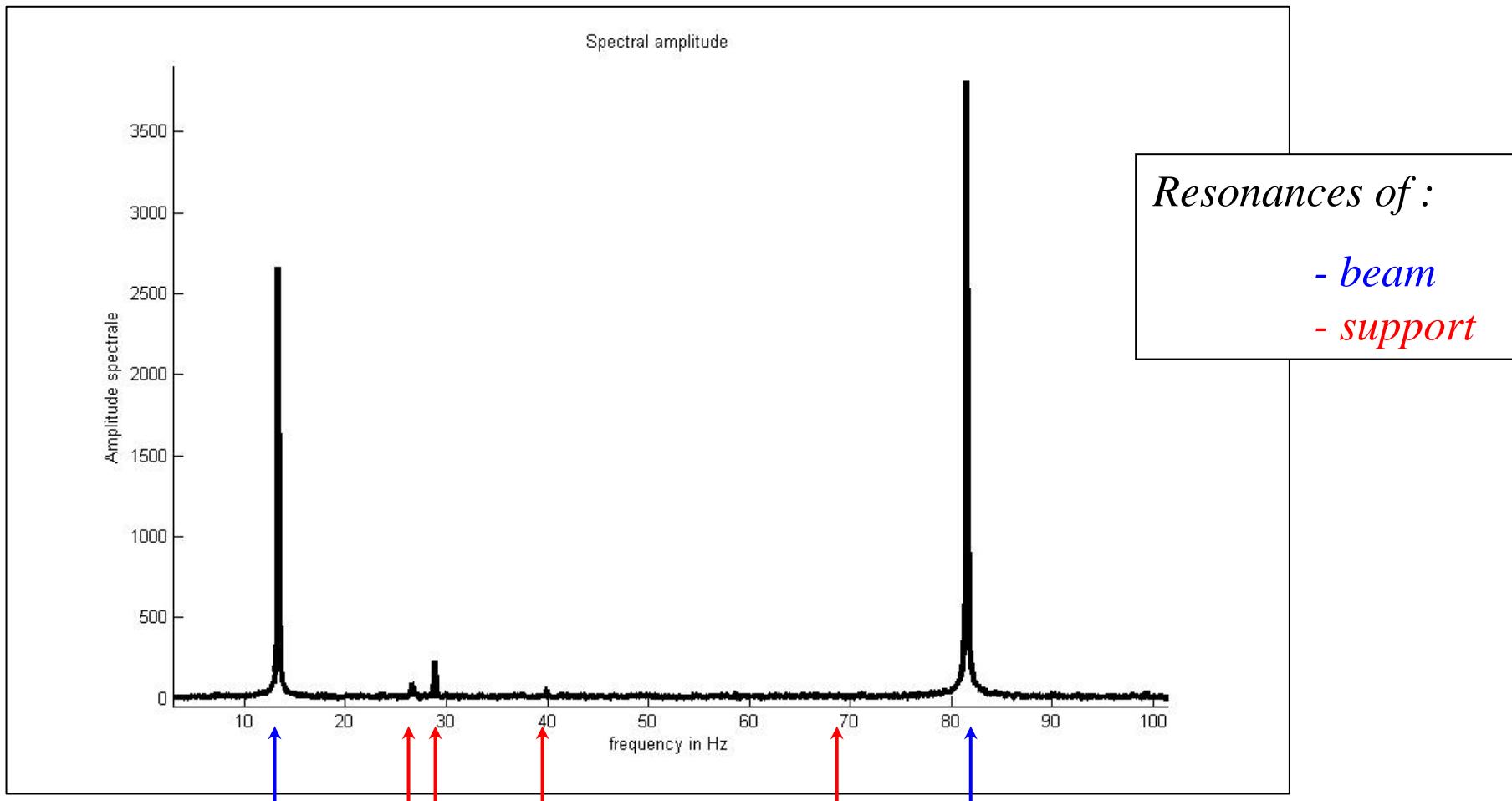


Active rejection





Active rejection

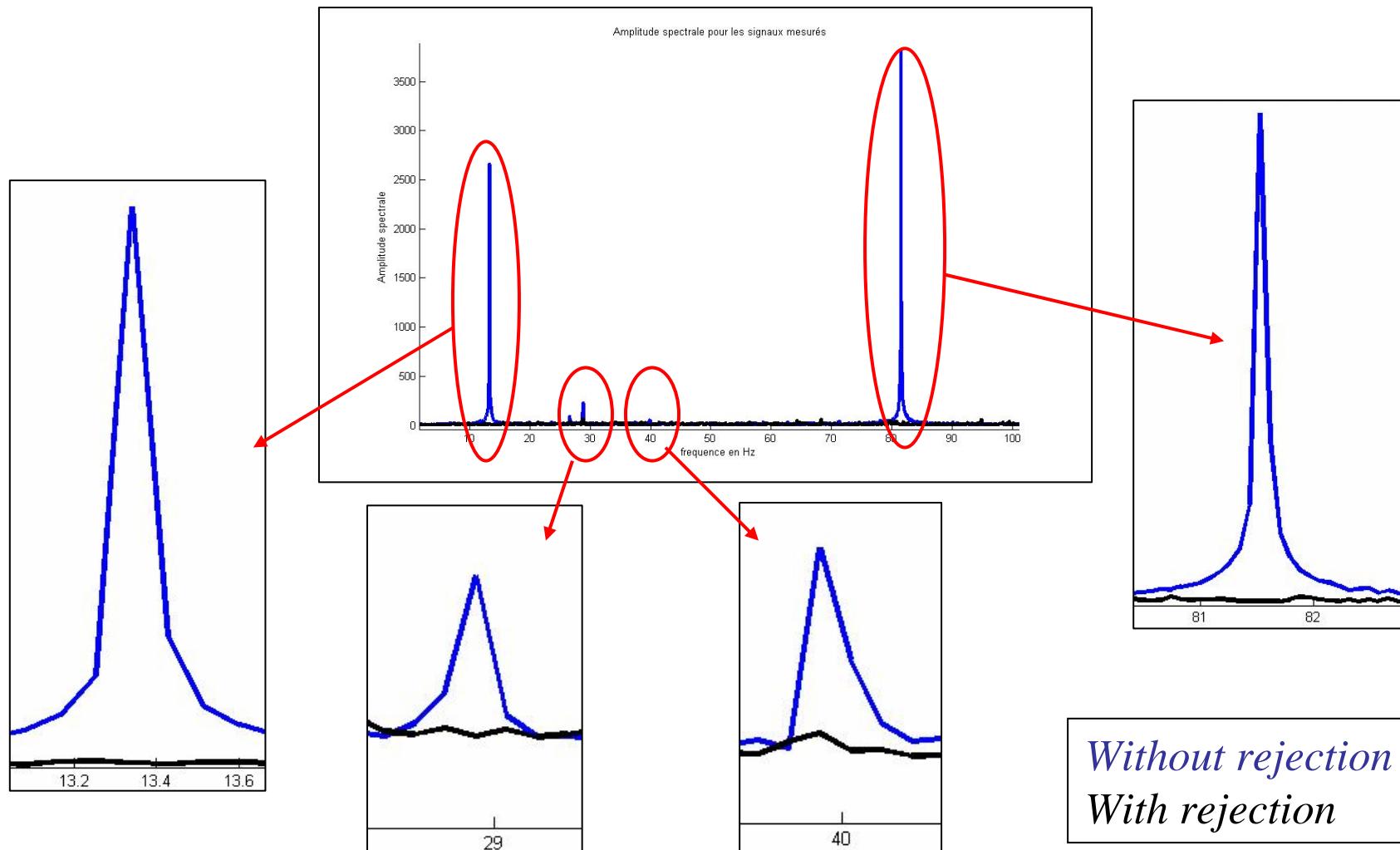


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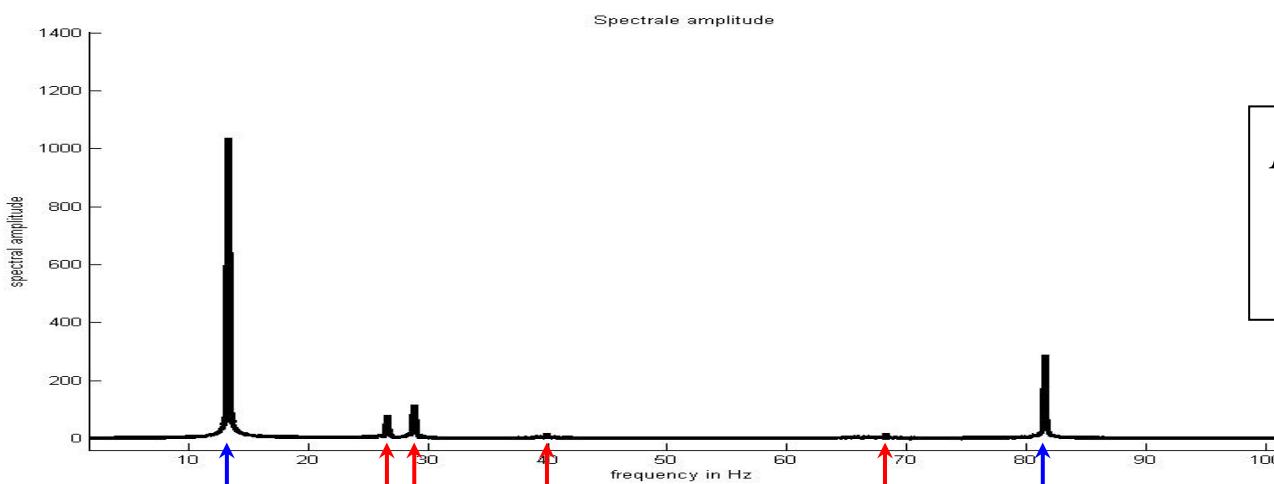
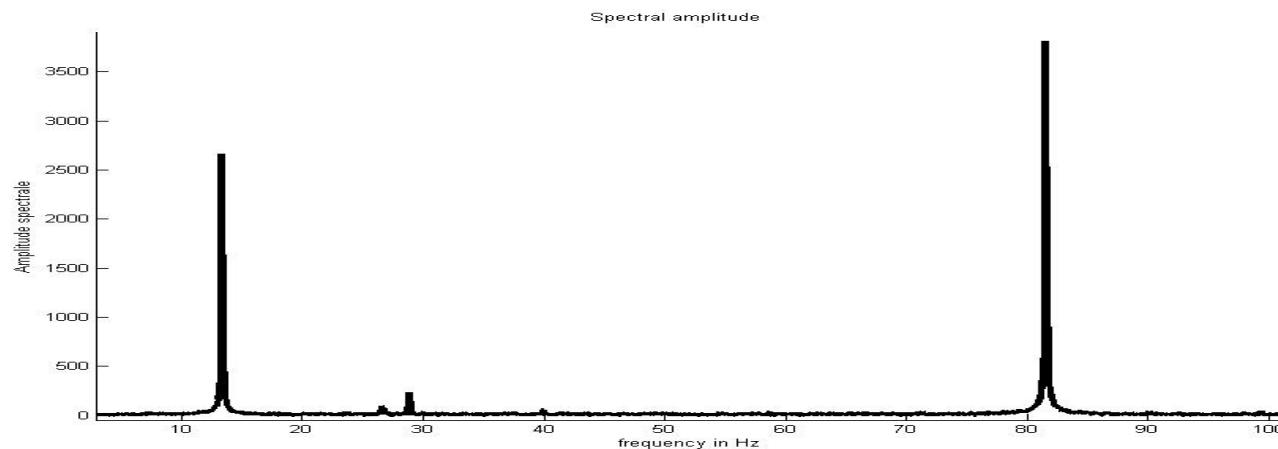


Active rejection





Active rejection



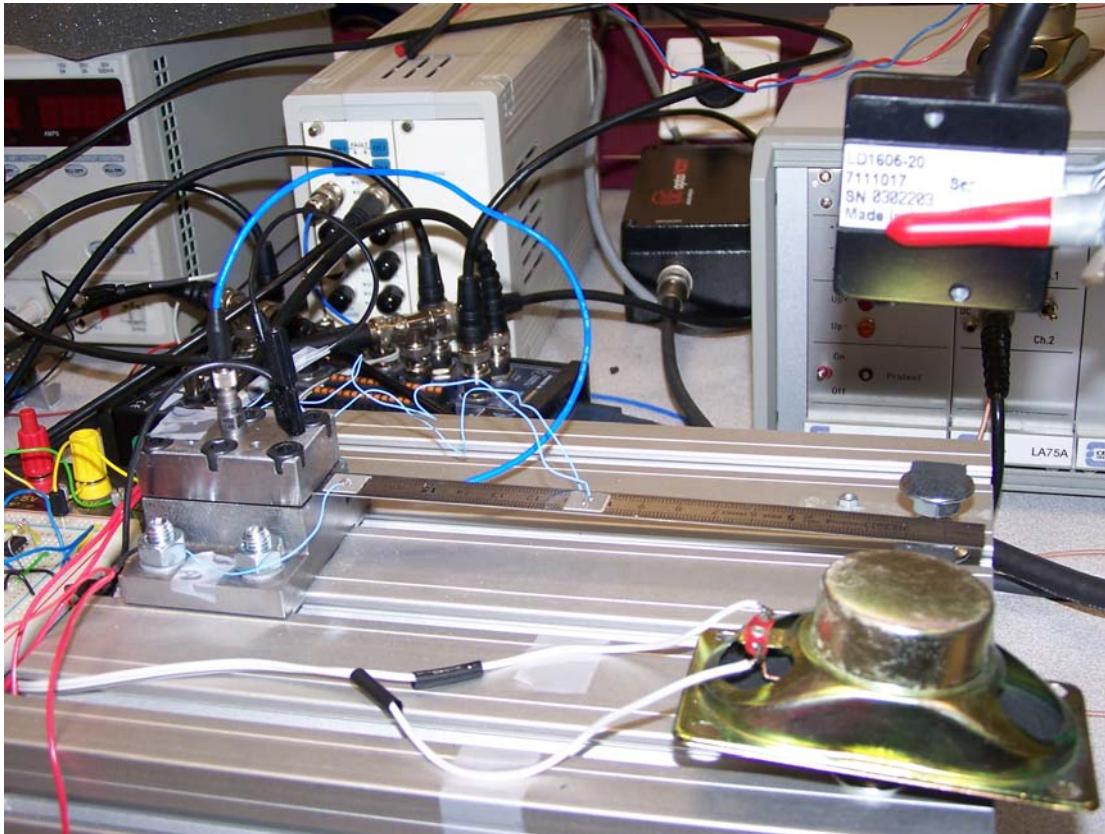
Resonances of:
 - beam
 - support

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21



Active rejection



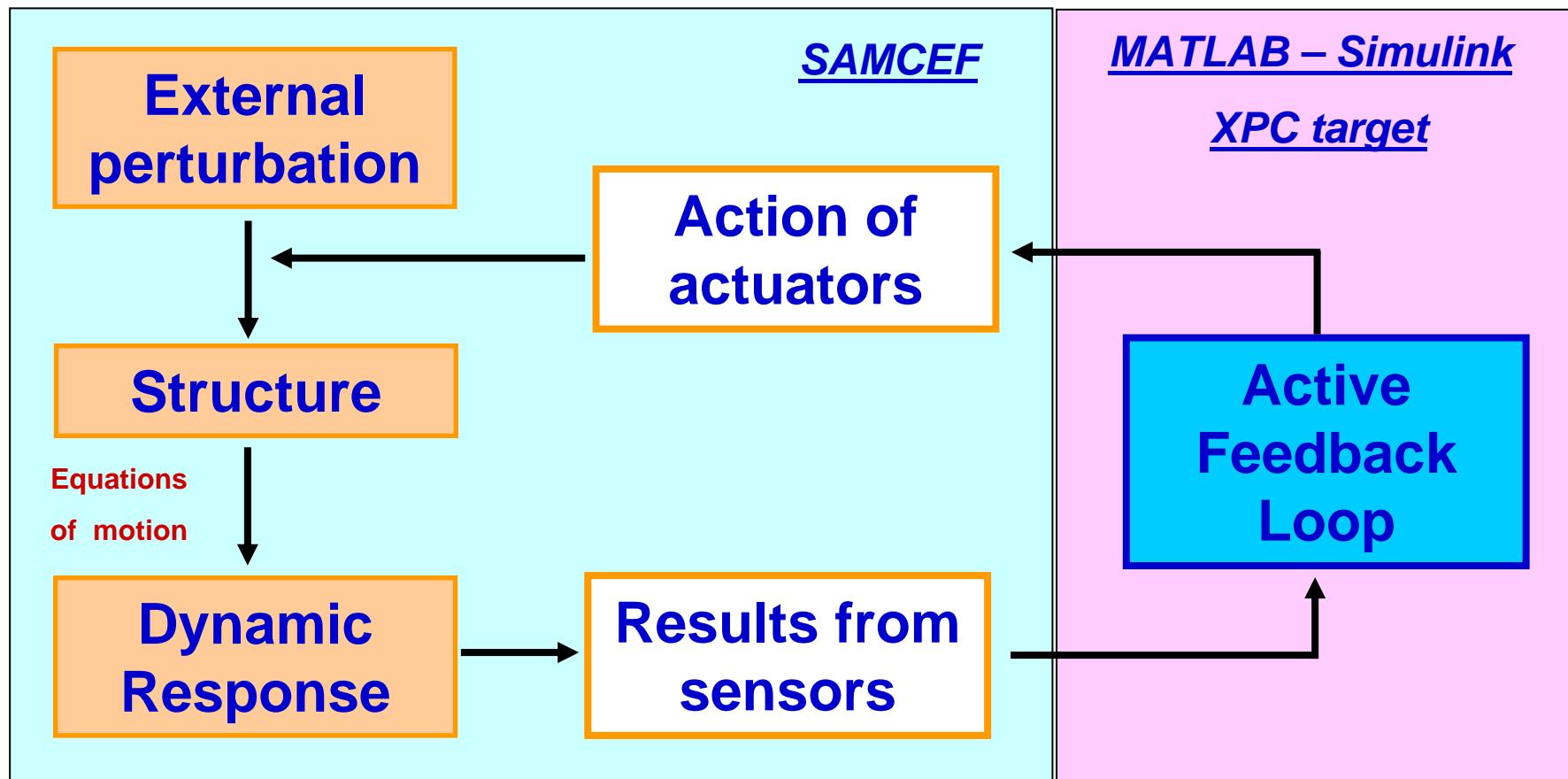
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Future work

Simulation of the WHOLE SYSTEM:

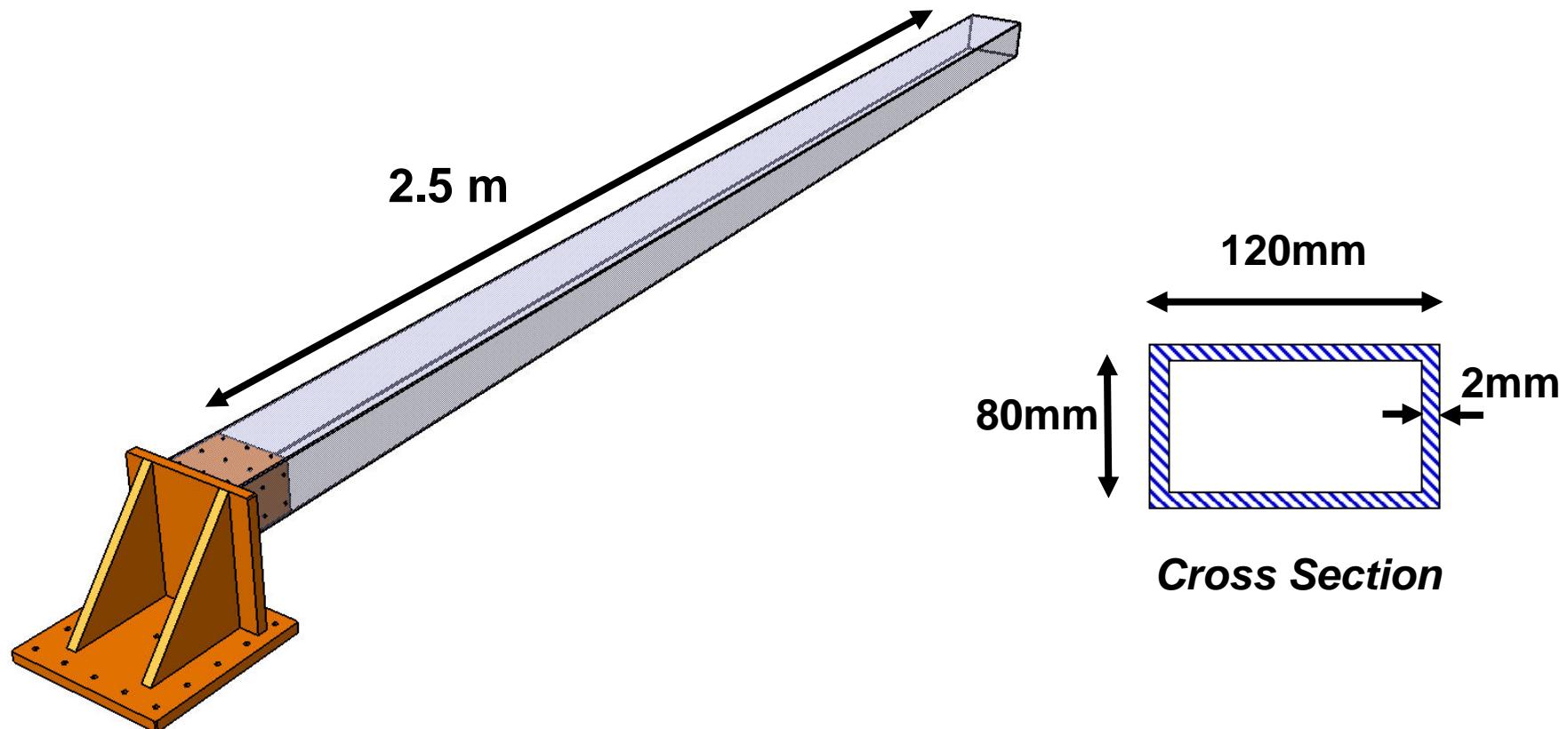


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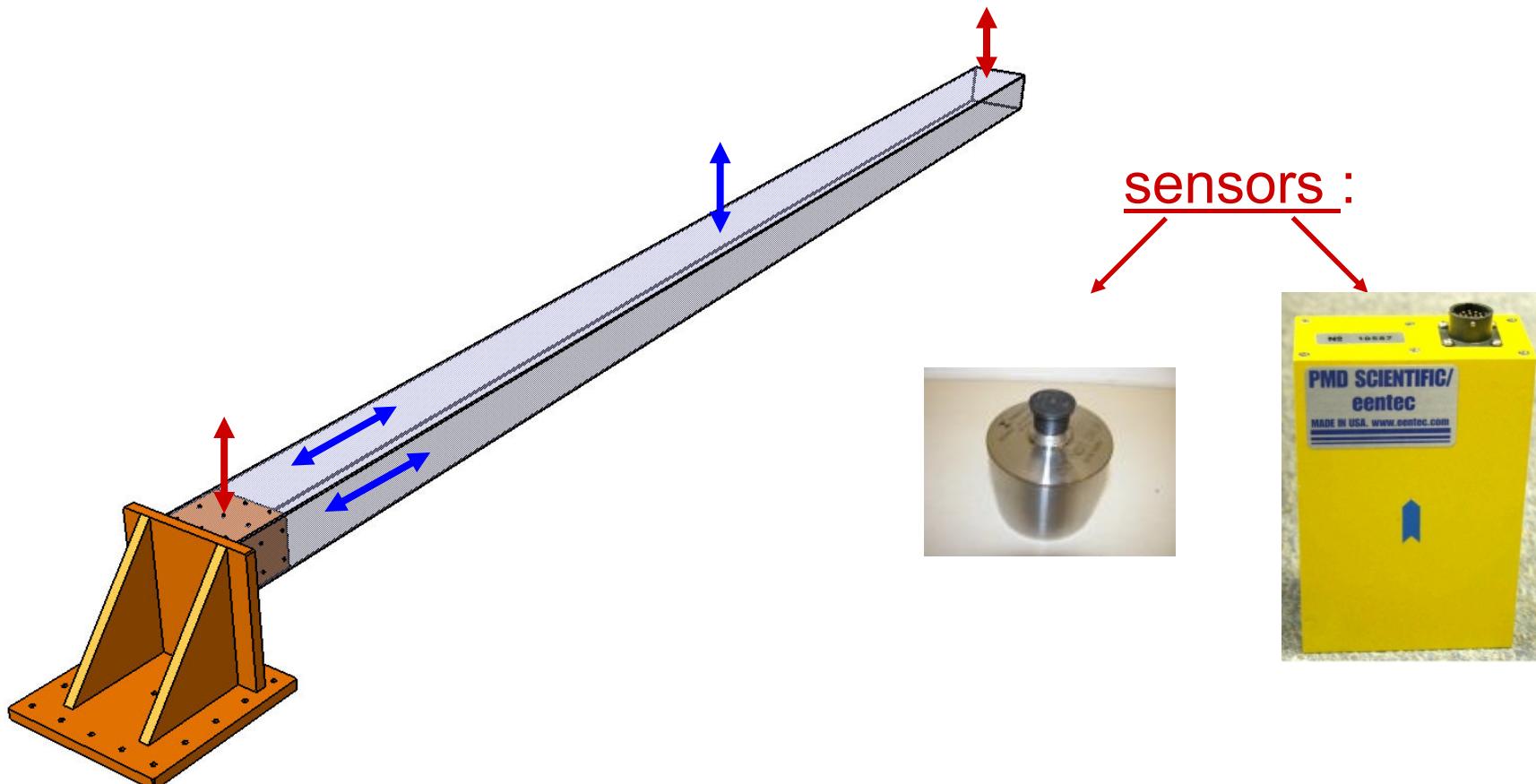
- **New Mock Up : fixed – free beam**





Future work

- Instrumentation of the beam : **sensors & actuators**



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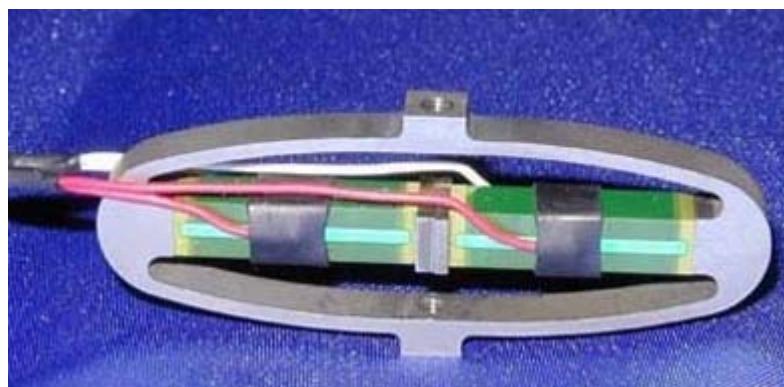
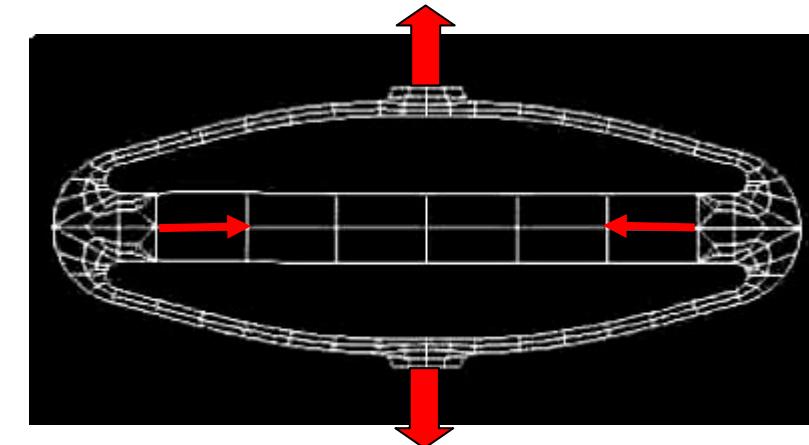
Actuators

Force = 194 N

Max. Ampl. = 52 μm

Resolution = 0,5 nm

15mm



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Future work

Deformation of
PZT cells

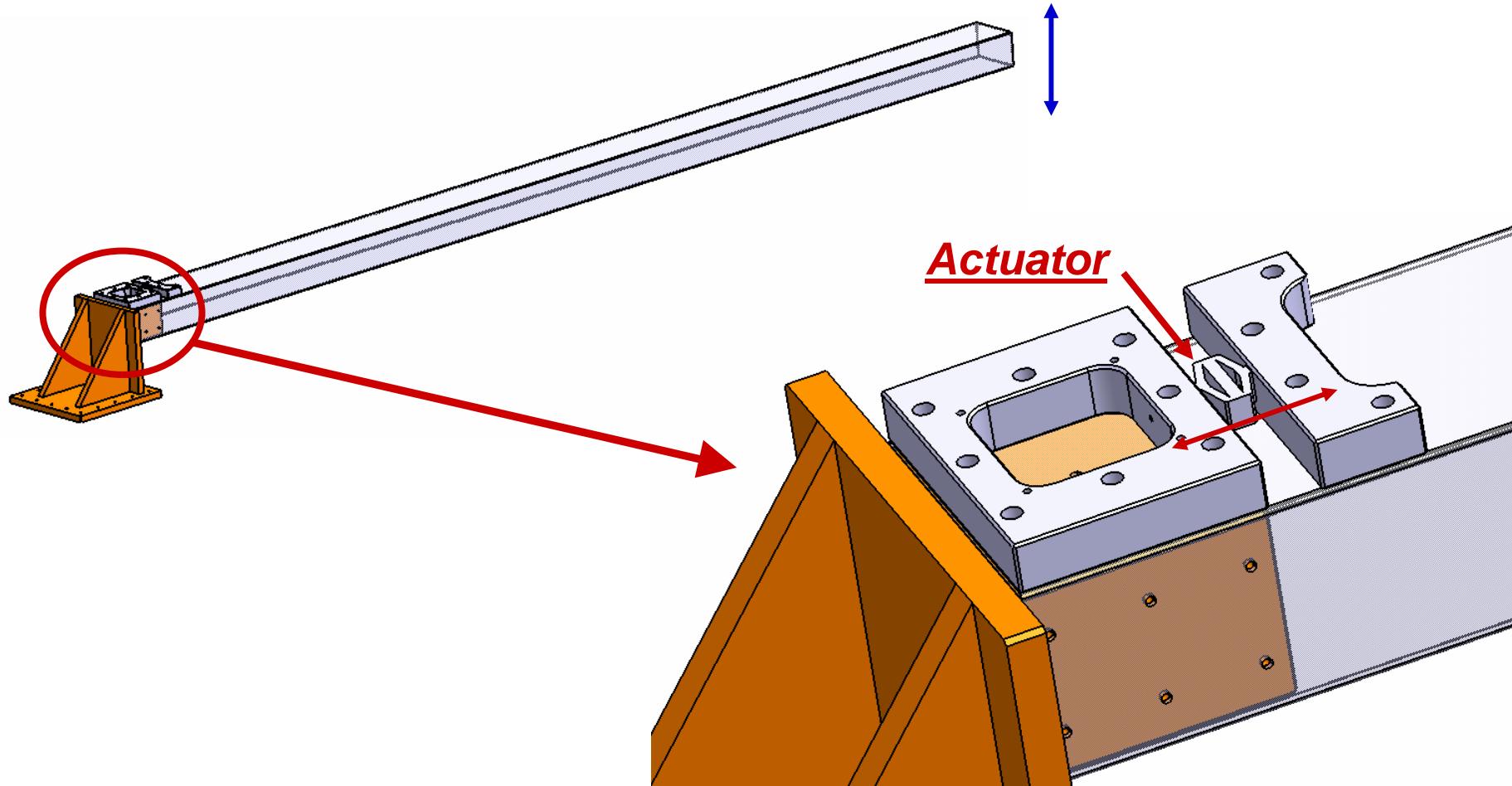


Amplified
deformation of
the steel shell

26



Future work

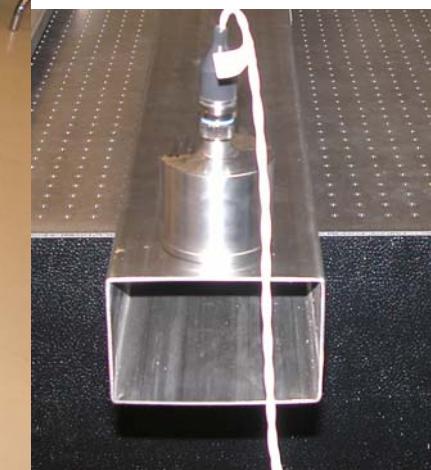
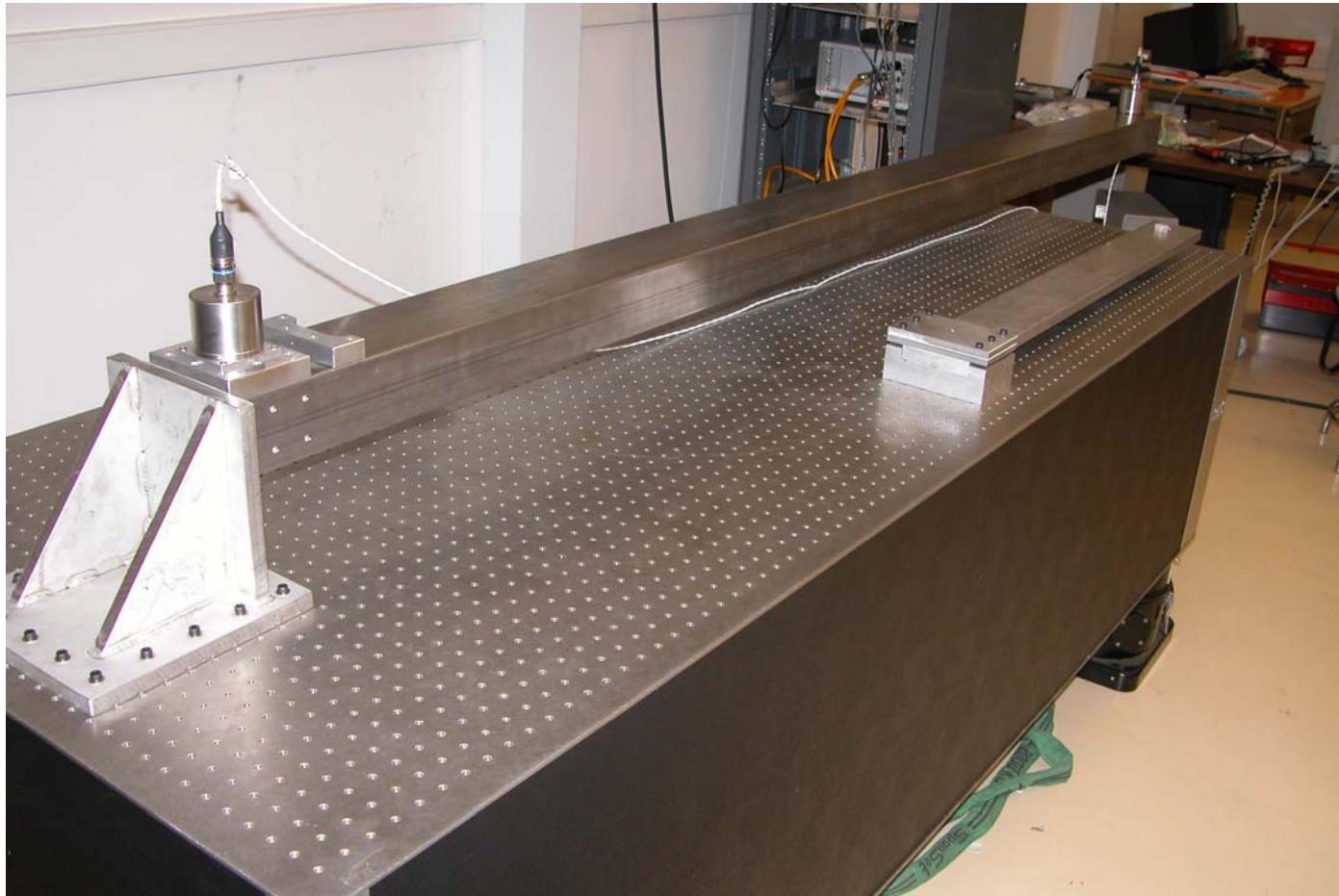


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Future work



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