

Micro-vibration Characterization Facility



CSEM's facility consists of a custom-designed multicomponent dynamometer comprising four three-component piezoelectric force sensors with very high sensitivity, capable of measuring in the mN range; high stiffness, with its first eigenmode above 2 kHz; and low-noise signal conditioning and acquisition system. The dynamometer is mounted on top of a high seismic mass in the form of a granite table and four pneumatic isolators to decouple the dynamometer from the surrounding environment.

The setup is therefore isolated from building vibrations which could perturb the measurement. The four force sensors are mounted within two plates, the lower plate is used to interface the dynamometer with the granite table, and the upper plate allows the mounting of the various components that need to be tested. Two different upper plate sizes are available. A cage can be mounted on top of the granite (Figure 3), which allows the suspension of vibration-sensitive passive components, such as sensors or electronic boards for characterization. Vibrations can be injected with suspended external shakers and measured with colocalized accelerometers.

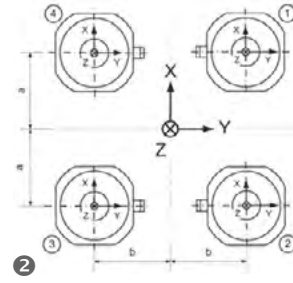
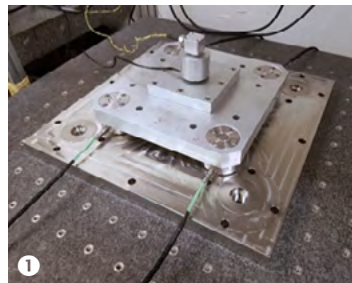
Features

- Multicomponent dynamometer with highly sensitive three-component force sensors
- High mass granite table on four pneumatic isolators to decouple from perturbation environment.



Applications

- Micro-vibration characterization for active components (e.g. motors, instruments, actuated structures)
- Spectral analysis for of exported forces for active components
- Sensor characterization with injected vibrations through external shakers.



1 Closeup of multi-component dynamometer with a proof mass actuator mounted on the top plate for characterization of exported forces.

2 Schematic diagram of force sensor arrangement in multi-component dynamometer (Source: Kistler).

3 Micro-vibration characterization facility at the observatory site of CSEM Neuchâtel, Switzerland: a multi-component dynamometer, big seismic mass over pneumatic isolators, charge amplifier and data acquisition (DAQ) system.

4 Summary of micro-vibration characterization facility specifications.

Name		Value				Remarks
Max. Payload Mass		20 kg				
Max. Payload Dimensions		150 x 150 x 150 mm 300 x 300 x 300 mm				With small top plate With large top plate
Measurement Range	F_x, F_y	0.04 - 200 N				
	F_z	0.05 - 400 N				
	M_x, M_y	0.06 - 60 Nm				
	M_z	0.006 - 120 Nm				
Frequency Range		5 Hz - 1.5 kHz 5 Hz - 1.0 kHz				With small top plate With large top plate
Sampling Frequency (f_s)		Up to 20 kHz				
Eigenfrequencies	x-, y-axis	2.55 kHz / 1.67 kHz				With small/large top plate
	z-axis	2.23 kHz / 1.14kHz				
Resolution		0.06 mN				For 1N range
Linearity		< 0.11%				
Crosstalk (forces)	(%)	F_x	F_y	F_z		
	F_x	-	0.7	-0.5		
	F_y	0.4	-	-1.1		
	F_z	-0.2	-0.1	-		
Background noise		< 3 mN RMS (at $f_s = 4$ kHz)				
Measurement uncertainty	F_x, F_y	0.16 %				
	F_z	0.10 %				
System Dimensions		430 x 430 x 81 mm				Dynamometer only