www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

MICROACCELEROMETRE BASED ON PULL-IN TIME

INL uses electrostatic pull-in dynamic behaviour of MEMS structures, fine-tuned to present high sensitivity to external acceleration.

There is an increasing number of applications requiring low cost and low power consumption technological solutions for high-resolution seismic and gravity measurements to enable the implementation of large networks of sensors. These include natural hazards monitoring, geotechnical surveying, navigation systems, and on-Earth or on-space missions, such as geodetic cube-sats or seismology-targeting missions.

The duration of pull-in non-linear transitions is very sensitive to external forces, under specific actuation and damping conditions. INL uses its **in-depth know-how** on the electrostatic **pull-in dynamic behaviour** of MEMS structures and the interaction of the several force contributions to measure acceleration with high sensitivity.

The MEMS structures are fabricated in a standard 3-masks 50 µm-SOI (silicon on insulator) process and encapsulated to maintain damping conditions and implement out-of-plane stoppers. Both **design and microfabrication** process have been optimized in order to obtain large proof-masses (170 mg over an approximate 10x10 mm^2 die area), springs with maximized compliance (3 N/m stiffness), and optimum damping.

The **current prototype** measures 13x12x1.5mm^3 per 1-axis MEMS die and has been used to demonstrate a sensitivity above 50 µs/(µm/s^2), corresponding to a 0.37 nm/s^2 acceleration resolution for 20 ns temporal resolution. Noise limit, set by thermal-mechanical noise of the microstructure, is set at approximately 80 nm/s2/√Hz for this prototype.

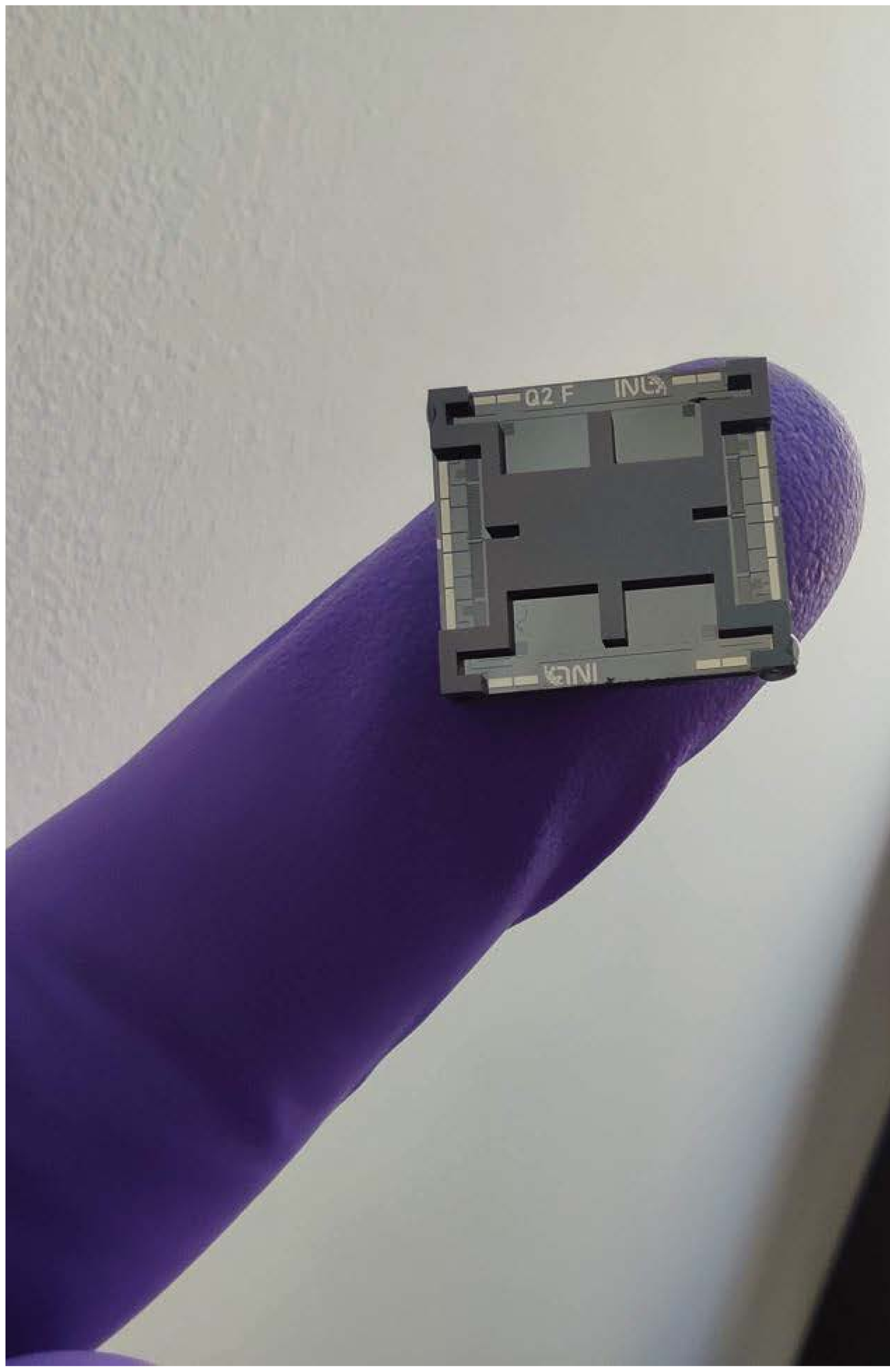
In accelerometers using capacitive transduction, the capacitive electronic readout is typically the bottleneck that limits sensitivity/resolution. The use of time transduction mechanisms has several advantages, including the possibility to measure time with high accuracy, resulting in a digital output with low-f noise.

+ Features

Tuneable sensitivity
Time-based transduction mechanism
Resolution/noise not limited by electronic capacitive readout

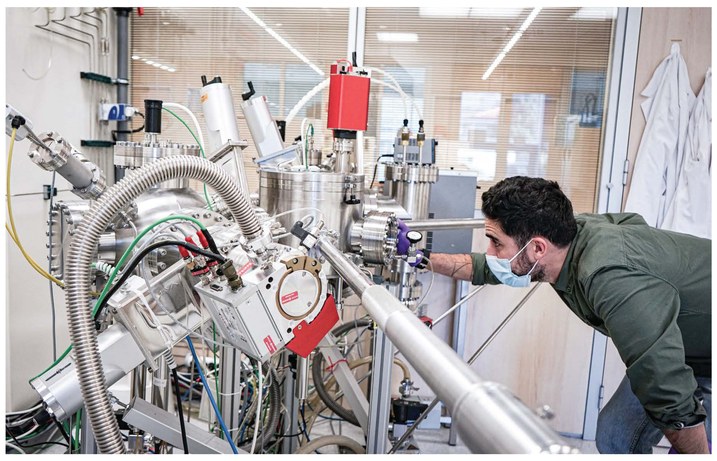
+ Suggested application

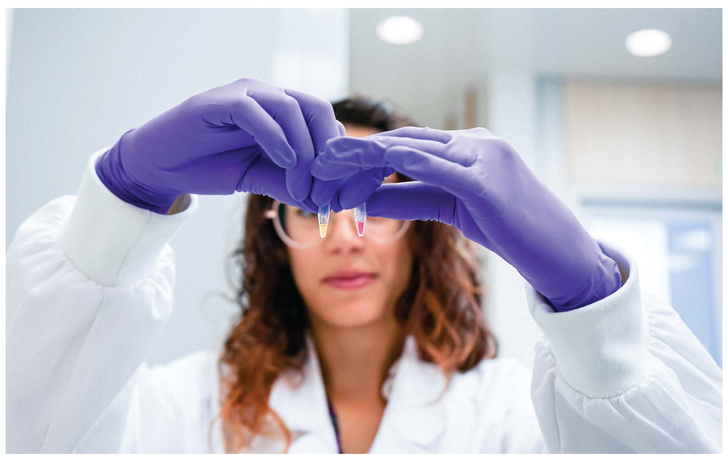
Gravimetry
Seismometry
Geotechnical surveying
Microgravity acceleration measurement systems

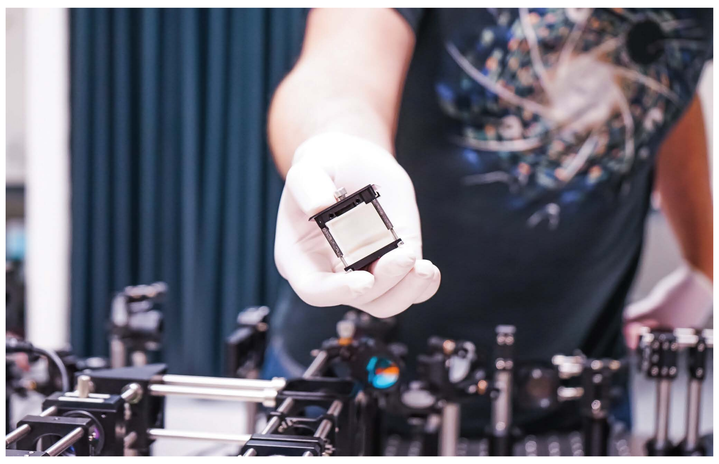


www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY







YOUR WORLDWIDE PARTNER FOR SCIENCE & INNOVATION

Shaping the future together in Clean Energy, Food, Health, Smart Digital NanoSystems, Sustainable Environment and Advanced Materials & Computing.

01 SCIENCE

Discover our areas of research and expertise, where we dive into nanoscience and intermix various disciplines to transform it into nanotechnology.

02 TECHNOLOGY

By nourishing on our multiple disciplines in house and with partners, we develop and deploy solutions to the market.

03 SERVICES

INL has state-of-the-art scientific equipment which can be used by internal and external stakeholders within the research, technology, and innovation fabric. You can access this open facility with expert support, either remotely or in-person, for full-service or for independent use after initial in-house training.

04 SOCIETY

INL is committed to disseminating to all audiences the nanotechnology concepts, bring society closer to our scientific developments. Visit our website and explore our activities and events.

For more information:

+ **innovation@inl.int**

www.inl.int
Av. Mestre José Veiga,
Braga 4715-330, Portugal

Follow us:

@inlnano

@inlnano

@inlnano

@inlnano

@INLInternationalIberianNanotechnologyLaboratory

INL User Facilities