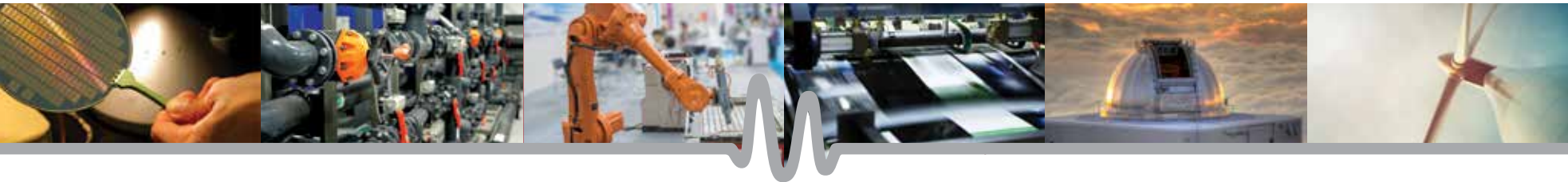




## OUR TOOLS



FEELING THE VIBES TOGETHER



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# WHO WE ARE

Micromega-Dynamics SA was incorporated in 1999 by two engineers specialising in mechanical engineering and robotics. The company currently has over 15 employees, engineers and technicians ready to meet your needs.

We are experts in the design and implementation of mechatronic systems used for active vibration control and we have developed 3 kinds of activity:

- The active and passive control of vibration in many fields of application
- The sensing system: we develop our own vibration sensors
- Structural mechanisms, for example actuators for telescope mirrors

For each of these activities our first priority is to offer a complete service, firstly by thoroughly analysing our clients' requirements and requests and then working on the design and prototype so we can provide and manufacturing the best solution. Once the solution is developed and installed by our technical team, we provide continued assistance and support to our customers. Our customers can call on us for a complete service or for a specific operation.

For over 15 years we have been developing state-of-the-art technology combining mechanics, electronics and real-time software. Our main objective is to detect the origin of a noise or a vibration in order to reduce or even cancel it.

95% of our business abroad takes place in Europe as well as more remote locations like Hawaii and Taiwan.



## VIBRATIONS AFFECT YOU DIRECTLY OR INDIRECTLY ON A DAILY BASIS:

- While travelling by train, boat, plane, bus or by car
- At home due to the noise generated by your heat pump
- On building sites when using industrial machines
- In factories where you can feel and hear vibrations from pipes
- Using your hair dryer in the morning
- Living near a wind farm

## VIBRATIONS AFFECT YOU BY:

- Causing you discomfort
- Adversely affecting the performance of your machines
- Shortening the lifespan of your machines
- Accelerating the breakage of parts, machines and structures
- Positioning you behind your competitors

## THANKS TO MICROMEGA YOU CAN INCREASE YOUR COMPETITIVE ADVANTAGE BY:

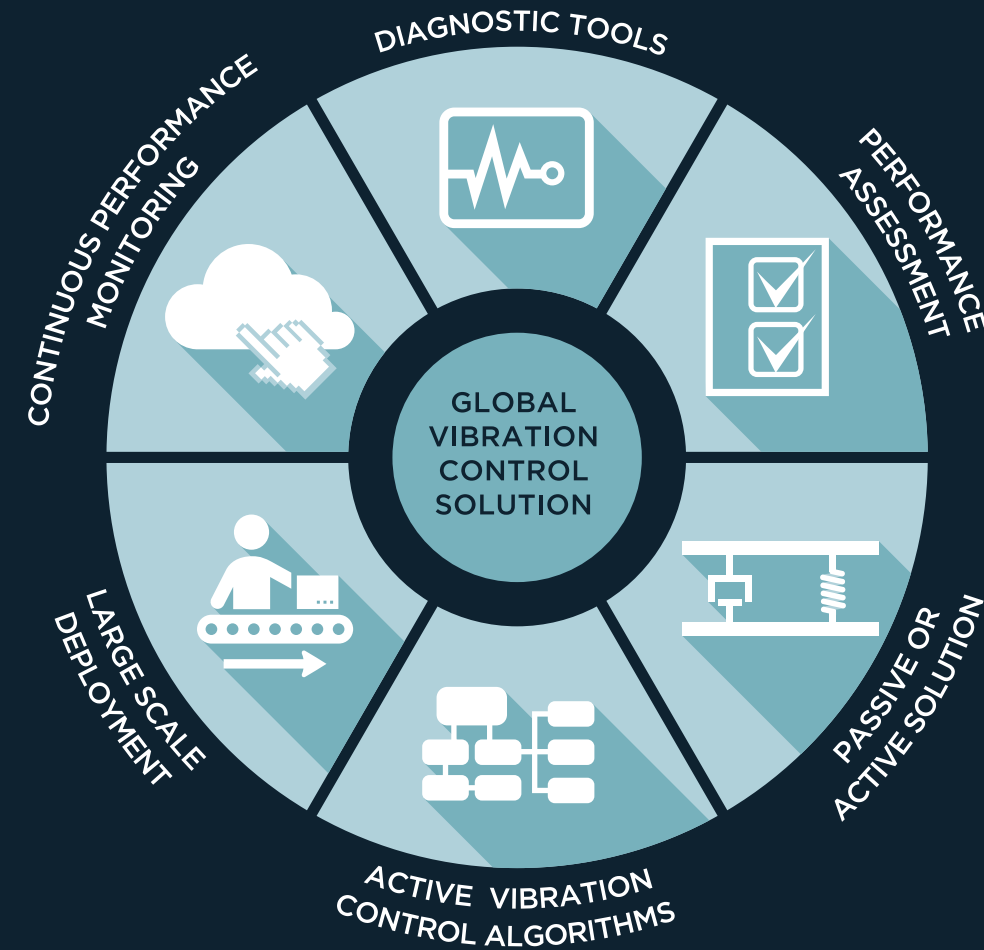
- Anticipating and avoiding breakages
- Improving the productivity and profitability of your machines
- Overrunning your competitors
- Optimising your maintenance

Imagine if this disadvantage was transformed into a competitive advantage! For a number of years, the company has been extending its activity within industry, mainly to include machine tools, wind turbines, scientific instruments and production machines for electronic components for which Micromega provides assistance with development as well as off-the-shelf or custom-made products.

Since 2009, we have been working with the German group Wölfel, specialists in the control of vibration and noise. This alliance means that today we are able to offer a wider range of services (measurement and engineering).



# GLOBAL VIBRATION CONTROL SOLUTION



## PASSIVE AND ACTIVE VIBRATION CONTROL SYSTEM

Vibrations are all around us and are increasingly linked to machine restrictions, whether this be the conventional limitation of machine performance (e.g. printing resolution) and machine reliability (fatigue and wear), or more sophisticated phenomena like chatter (machine tool instability) or control-flexibility interaction.

If you have an issue with vibration, we will visit your site and carry out a diagnostic procedure so that we understand the origin of the problem. We will then propose active or passive solutions and evaluate the expected level of performance. After we have installed your solution, we offer an ongoing performance and monitoring service.

Our field of application for vibration reduction devices is wide-ranging:

- Chatter avoidance, surface finish improvement, noise reduction in machine tools
- Compressor noise reduction in the energy sector
- Prevention of leaks and fatigue reduction in piping
- Flutter control, comfort improvement, and fatigue
- reduction in civil engineering

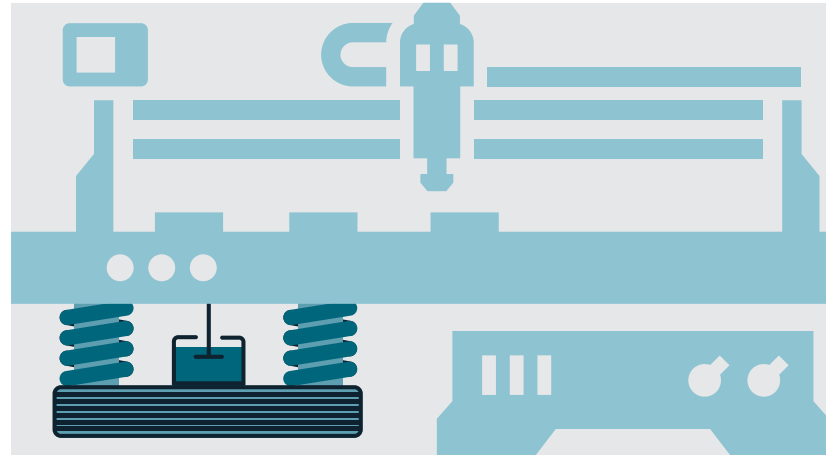
- Fatigue and noise reduction in wind energy
- Graving quality and accuracy improvement in microelectronics and micro-lithography machines
- Printing quality, photo paper surface finish improvement in the paper industry

## OUR TOOLBOX

### AUXILIARY PASSIVE DAMPERS

We design and manufacture custom-made passive Tuned Mass Absorbers (TMA) and Tuned Mass Dampers (TMD)

that can drastically reduce mechanical vibrations in a given frequency band.



### ACTIVE DAMPING DEVICE & RELATED CONTROLLERS

Active dampers are based on the principle that accelerating a suspended mass results in a reaction force on the supporting structure. An embedded sensor monitors the supporting structure vibration. The sensor readings are sent to an external feedback controller that drives the internal electromagnetic actuator of the active damping device.

As it does not rely on a model of the structure to be controlled, a rather simple control algorithm can be implemented. It will work theoretically on any type of structure and will damp any vibration mode that is observable in its open-loop transfer function. The only selectable parameters for the control system are the actuator/sensor location and the feedback gain.



INTUITIVE



HIGH  
RESOLUTION



CUSTOMISABLE

## OUR EXPERTISE

- Fast performance assessment
- Selection of appropriate control scheme
- Robust control laws
- Development of industrial solutions for harsh environments

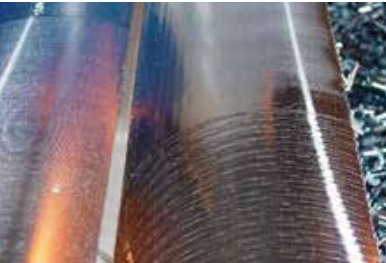


# EXAMPLES OF APPLICATIONS

## MACHINE TOOL CHATTER CONTROL

Chatter vibrations limit the productivity of heavy-duty milling and turning processes by reducing the maximum cutting depth. Chatter is a self-exciting phenomenon that can be reduced by increasing the structural damping of the machine critical modes. Several custom-made

Active Damping Devices (ADD) have been developed by Micro-mega to improve the technical capacity of customers' machines. Compared to passive Tuned Mass Dampers (TMD), ADD experience a lower weight and are insensitive to machine frequency changes.



## TUNED MASS ABSORBER FOR NOISE CANCELLATION IN WIND TURBINE

Wind turbine Tonalities are sounds at discrete frequencies peaking above broadband noise. While the acoustic power associated with them is rather low, these can be very annoying and therefore, in their presence, a penalty is placed on target maximum broadband noise levels (up to -6dB). This then has an impact on the maximum blade velocity, hence the generated power (up to -30%). TMD Sound reduces turbine tonalities by preventing the vibration generated by the gearbox from reaching the emission

areas (tower, blades, etc.). It consists in passive Tuned-Mass Absorbers (TMA) mounted on the gearbox torque arms. At the tuning frequency, the vibration produced by the gearbox is transferred into the tuned mass absorber rather than in the tower, hence the avoidance of sound generation. TMAs have an absorption bandwidth of a few hertz and can be tuned to any frequency between 50Hz and 350Hz, addressing most of the tonalities generated by the first and second stages of a gear-box.



## TUNED MASS DAMPER PIPE

TMD Pipe (TMD stands for Tuned Mass Damper) is a passive damper for the reduction of vibrations in piping systems and is composed of a mass, springs and dampers. Functional principle: the TMD tuned to the resonance of the piping system increases the damping significantly, thus reducing the resonant amplitudes. TMD Pipe has been specifically developed because conventional vibration reduction methods have significant deficits. Conventional absorbers and snubbers require rigid abutment.



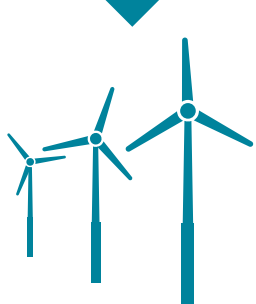
As a purely mechanical structure TMD Pipe does without electrical components so that it can easily be used in hazardous areas. Moreover, it requires no external power supply. This makes it more reliable, during earthquakes, for example, where full operation is required even during power failure. TMD Pipe has been specifically developed for industrial use in facilities such as those within the chemical industry or in power plants. All components have increased corrosion protection. In addition, it operates reliably even under rough and changing environmental conditions.

## SOUND REDUCTION IN WIND TURBINES

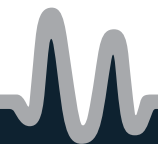
One actively controlled absorber ADD Sound is mounted at each torque support together with a small control cabinet in the nacelle. Tonal sound is cancelled over the entire range of speed.

Advantages:

- Broadband and multi-RPM tonality cancellation
- Less design space needed (compared to passive TMD Sound)
- Can be retrofitted



# GLOBAL MONITORING SOLUTION AND SENSING SYSTEM



## SMART SENSING, ACQUISITION AND SUPERVISION

We are experienced in carrying out in-the-field diagnostics of a given situation. After our diagnostics, we design and manufacture sensing and monitoring systems measuring physical parameters in extreme environments.

We are able to achieve a high level of integration of mechanics, electronics and software, knowing that the designed sensing device has to operate reliably in harsh environments.

One example is our Structural Noise Sensor (SNS Blade) installed in wind turbine blades

as part of a Structural Health Monitoring System (SHM Blade) that continually checks the blades' structural integrity and/or ice deposit. Integrated sensing elements (acceleration and temperature) have to be highly sensitive without being influenced by the strong magnetic perturbations present in wind turbines. They experience very large temperature variation while maintaining good accuracy. And - last but not least - they must survive thunderstorms with no alteration to their performance.

Another example is our hand-arm vibration metre. It is a highly integrated vibration data logger that is attached to hand-tool handles in order to compute the vibration dose the worker is exposed to. On some highly percussive tools, it has to measure and sustain as much as 5000g shocks, execute standardised filtering and log data for long periods.

We design sensors, acquisition systems and processing algorithms, separately or in any combination for specific applications and environments.



## OUR TOOLBOX

### RECOVIB TINY

The RECOVIB Tiny is a smart autonomous, wireless acceleration recorder. It can be connected to a PC or a smartphone via USB for measurements download.

The provided software allows for millisecond level time synchronisation between sensors, the selection of the measuring range as well as the programming of the measurement duration.



STAND ALONE



SYNCHRONISATION



EASY TO USE

### RECOVIB INDUSTRIAL ACCELEROMETERS

The RECOVIB industrial accelerometers bridge the gap between the performance of laboratory accelerometers (which are often expensive, fragile and offer low protection) and the robustness of industrial accelerometers (which are sometimes cheaper but often noisy and inaccurate).

Our accelerometers can be deployed in industrial environments for monitoring machinery or structures.

The RECOVIB accelerometers have a proven design and the majority of the models available are widely used in a variety of fields, such as machine tools,

precision machining and on-shore and off-shore wind energy sectors in monitoring or active vibration control applications.



HIGH RESOLUTION



INSENSITIVITY TO EXTERNAL ENVIRONMENT



EASILY INTERFACED TO A PLC SYSTEM

### ACQUISITION SYSTEM DAQ 1

Once powered on the RECOVIB. DAQ continuously acquires and pre-processes sensor signals.

The processed data is stored in local files (RAMDISK or solid state disk).



Those local measurement files are then made available to the user through the internet either directly (e.g. FTP access) or indirectly through a remote server. The remote server solution allows for larger data storage or further signal processing.

The RECOVIB.DAQ can also synchronise the acquisition process to a reference public time server (NTP - Network Time Protocol client).

Finally, the RECOVIB DAQ is programmed to send emails following the occurrence of particular events or the detection of an abnormal situation.

## OUR EXPERTISE

- Development of high-performance electronics with protection against external perturbations (Electromagnetic interferences, high or low temperatures, lightning, etc.)
- Structural health monitoring approaches
- Development of industrial solutions for harsh environments



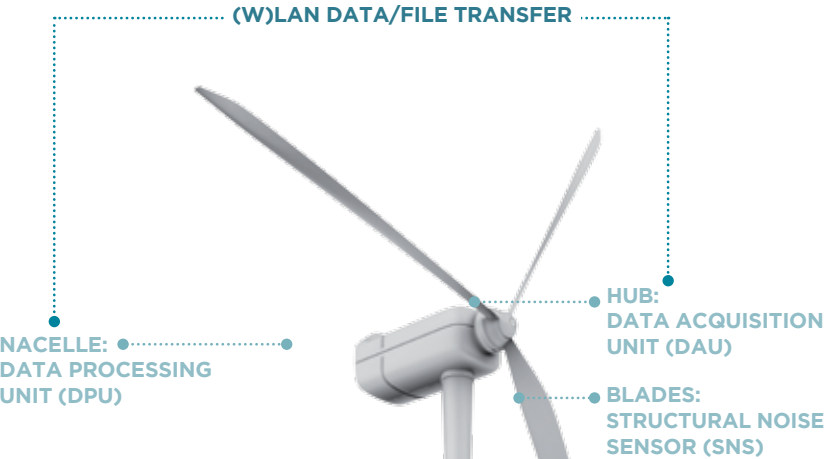


# EXAMPLES OF APPLICATIONS

## STRUCTURAL HEALTH MONITORING FOR BLADES IN WIND TURBINES

SHM Blade detects structural changes relating to a certain reference condition. This reference condition is determined fully automatically without any help from the outside and individually for every single rotor blade immediately after the activation of SHM Blade. Such a blade-specific learning phase ensures high sensitivity to damage despite the mass and stiffness tolerances caused by production.

After completion of the learning phase the system continuously calculates condition indicators, which furnish information on the current condition of the blade at all times. By means of a two-level warning and alarm concept the system control is capable of reacting to and preventing subsequent damage. More detailed information can be provided via a web interface of the backup and monitoring system.



## STRUCTURAL HEALTH MONITORING FOR ICE DETECTION IN WIND TURBINES

IDD Blade detects ice on rotor blades. As the sensors in the rotor blades directly record the actual icing condition, the results are much more reliable than an

assessment based on meteorological parameters. Ice detection with IDD Blade is available as an option to SHM Blade.



## HUMAN VIBRATION METER VIB@WORK

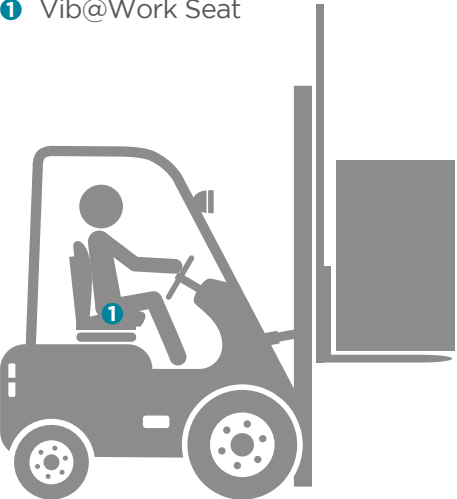
In order to help companies to comply with health and safety requirements regarding the exposure of workers to the risks arising from vibrations, Micro-mega Dynamics has developed a complete range of vibration metres. Based on an innovative concept, the Vib@Work Hand-Arm and Whole-Body vibration metres automatically measure

operators' daily vibration exposure. Vib@Work Hand-Arm and Whole-Body are the next generation of human vibration metres/monitors.



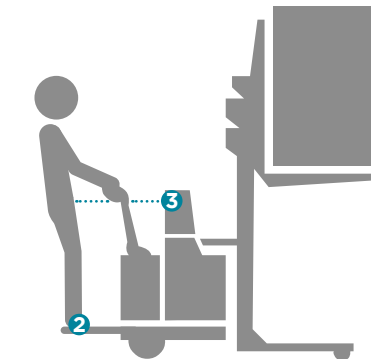
### SEATED OPERATOR EXPOSURE

- 1 Vib@Work Seat



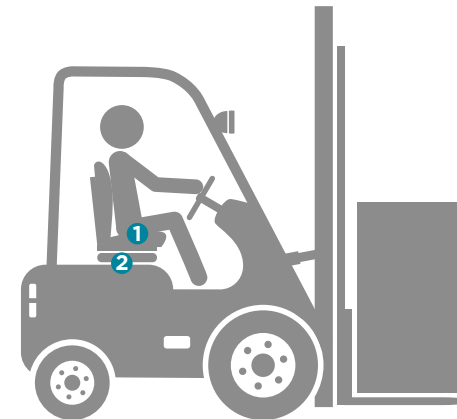
### STAND-UP OPERATOR EXPOSURE

- 2 Vib@Work Floor
- 3 Vib@Work Detect

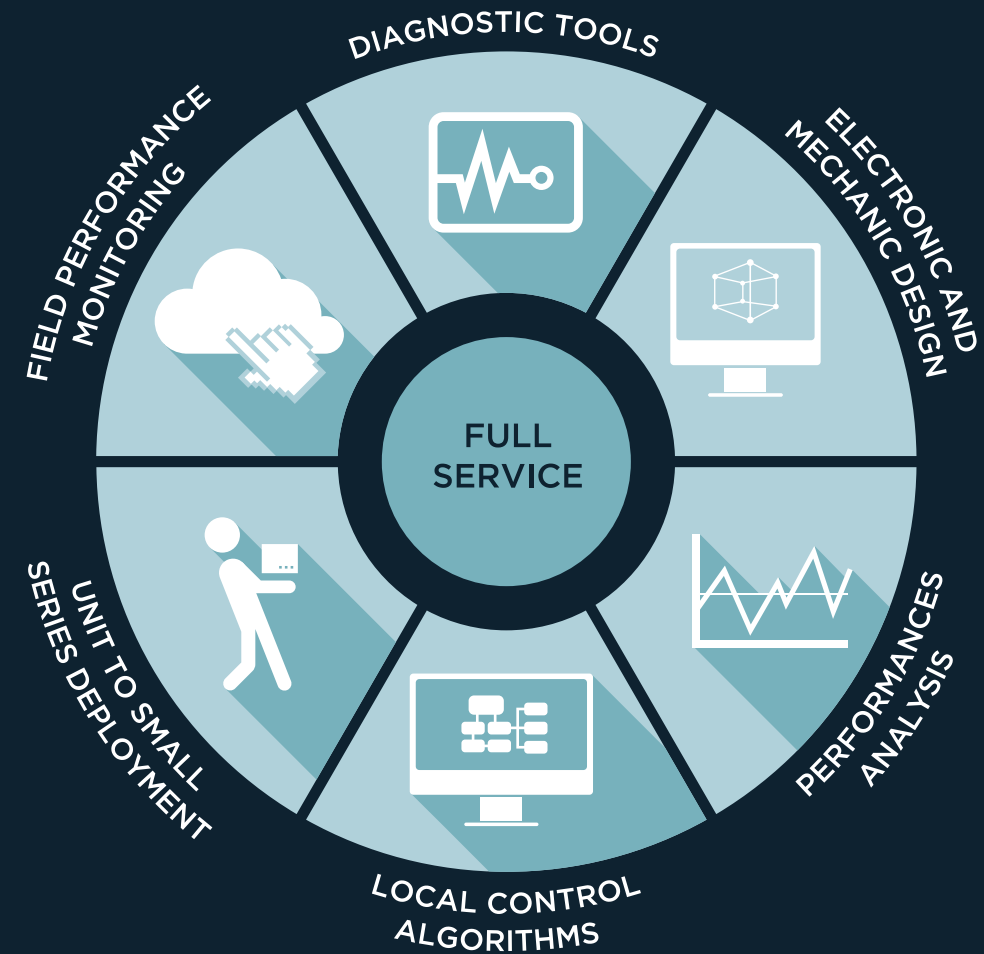


### S.E.A.T. FACTOR

- 1 Vib@Work Seat
- 2 Vib@Work Floor



# STRUCTURAL MECHANISMS



## NANOPOSITIONING, SHAPE CONTROL AND ACTIVE DAMPING

Micromega Dynamics offers high-precision mechanism concepts to meet client requirements. We are able to design mechanisms that achieve a high level of in-

tegration of mechanics and electronics. Furthermore, by using rugged electronics and local control algorithms our mechatronic devices operate reliably in harsh environ-

ments. Performance analysis on prototypes is used to qualify our mechanisms before deploying the devices on site.

## OUR TOOLBOX

### ACTUATORS BUILDING BLOCKS

- Magnetic bearings
- Compliant supports
- Dedicated electronics
- Sensors

### HEXAPODS

- Stiff leg
- Soft leg

## OUR EXPERTISE

- Development of high-performance electronics with protection against external perturbations (electromagnetic interferences, high or low temperatures, lightning, etc.)
- Structural health monitoring approaches
- Development of industrial solutions for harsh environments



### MIRROR SHAPING

The resolution of astronomical telescopes usually depends on the primary mirror aperture (its diameter) but also on the quality of its surface finish, the defects of which lead to imaging errors. The defects are originated either during the manufacturing/ assembling process (polishing errors) or during the life of the telescope (gravity loading, thermo-mechanical stresses, wind, etc.).



PNEUMATIC



HIGH  
RESOLUTION



LOCAL CONTROL  
ALGORITHMS



### ACTUATORS

In the past, thick mirrors were used to avoid these later defects. Nowadays, thinner and lighter mirrors are used in combination with special actuators applying very precise loads (0.02%FS) at the back of the mirror. Additionally, these actuators must also be very compliant in order to avoid parasitic loadings due to the relative motion between the mirror (made of glass) and the mirror cell (made of steel). Finally, the power dissipated by the actuator must be very low (<1W) in order to avoid local heat generation at the back of the mirror.

### ACTIVE DAMPING INTERFACE

The Active Damping & Steering Interface consists of a stiff six-degrees-of-freedom hexapod (Stewart platform with cubic architecture). Each leg consists of a linear piezoelectric actuator, a collocated force sensor and flexible tips for the connection to the base plates. The hexapod can be used as damping interface connecting arbitrary structures, a micro-vibration isolator and a high-precision pointing mechanism.

Optionally, the legs can be provided with strain or elongation sensors, so that the hexapod can be used as an interface with infinite stiffness at low frequency. The maximum axial stroke is 90 micrometers and the maximum tilt is 0.4mrad.



PIEZOACTUATORS



PASSIVE OR  
ACTIVE SOLUTION



6 AXES



### MAGNETIC BEARING FOR OPTICAL DELAY LINE

Optical Delay lines are used in advanced optical systems (e.g. aerospace applications). Here the objective is to make a high-resolution/ long-stroke positioning device for a synthetic aperture optic. The resolution is usually a nanometre or less while the stroke can be several tens of millimetres. Because they are mainly used in cryogenic environments, the total power dissipation is always in the range of the milliwatt or less. Magnetic bearings were designed to produce a smooth reliable frictionless movement and the positioning of the optical payload.



ASTRONOMY



CRYOGENIC



MAGNETIC  
LEVITATION





# OUR INFRASTRUCTURES TO SUPPORT OUR ACTIVITES

- State-of-the-art electronical and mechanical design software
- Finite Element analysis software
- Very low frequency, long stroke shakers
- 3D printer for fast mechanical prototyping
- High density electronics assembly line for prototyping and small series
- Climatic chamber
- Well equipped manufacturing facilities
- ISO 9001 certified
- Collaboration with external testing facilities, e.g. Electromagnetic compatibility laboratory, high-voltage laboratory for lightning protection, design, testing, certification, etc.

## OUR STRENGTHS

- Strong collaboration with our customers, taking into account their field experience from the design phase
- Experience in the selection of materials and processes
- Experience in mechanical design (i.e. Finite Element Modelling, fatigue analysis, etc.).
- Experience in electronics design: selection of industrial, automotive or military grade components, as appropriate, worst-case analysis.
- Trained personnel accustomed to practising high standards of workmanship
- Design and manufacture of dedicated test benches
- Experience in field commissioning and servicing around the world: i.e. wind turbines, steel plants, machine tools, paper mills, etc.





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