



European Metrology Research Programme

Industrial innovation II

An overview of the funded projects from the Targeted Programme Industry II.

The aim of these projects is to use cutting-edge measurement science to drive innovation in industry and facilitate new products.

The projects focus on new applications at the crossroads between different technologies to improve efficiency and effectiveness in high-tech industries and key industrial sectors, in order to ensure European industry remains globally competitive.

Large object measurement

Measuring parts for cars, planes and ships

Large volume metrology is the measurement of the size, location, orientation and shape of large objects such as car, plane and ship parts. As these objects are often too large to transport, the measurements need to be made at industrial locations.

Laser trackers, photogrammetry and indoor GPS are the instruments commonly used to make these measurements, but all are limited by technical issues and the environment in which they operate. For example, a measurement made on a factory floor or in an aircraft hangar will not be as accurate as one made in a dedicated measurement laboratory.

This project will develop new systems for large volume metrology as well as the necessary knowledge to make existing methods faster, more flexible and more accurate in industrial environments. By improving measurement quality, it will provide new opportunities for designing complex parts such as aircraft laminar flow wings, which can help significantly reduce aircraft emissions.

Project IND53: Large volume metrology in industry

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projects.npl.co.uk/luminar/



Nanoscale measurements for small electronic devices

Controlling strain at the nanoscale

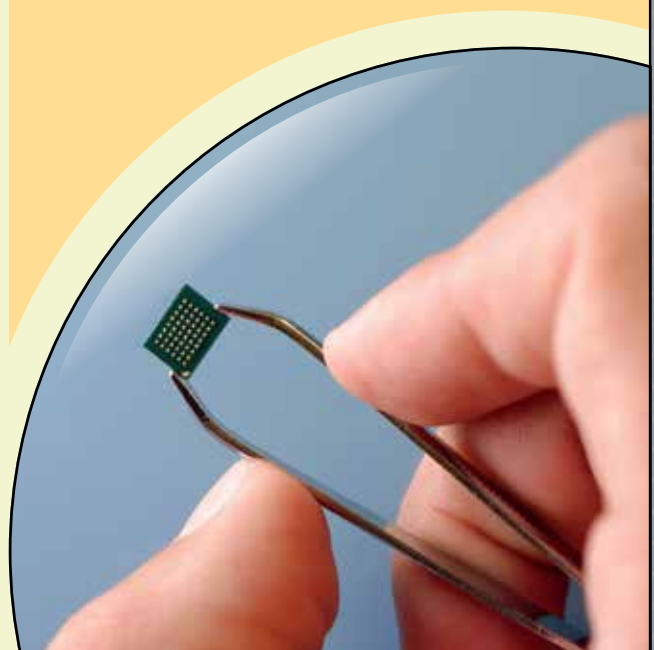
Faster, smaller and more energy efficient computing, based on miniature electronic devices, will benefit almost every industrial sector. Recently, materials such as piezoelectrics have been used to develop miniature electronics by allowing the control of properties at the nanoscale via the application of mechanical strain. Piezoelectric materials are uniquely capable of generating precisely defined strains down to very small length scales and are the technology driver for new types of electronic devices.

Currently, there is no measurement framework or facility for traceable measurement of the electromechanical coupling (shown as strain through application of voltage) in piezoelectric materials down to a size of 1 nm.

This project will develop traceable measurements of strain at lengths down to 1 nm and at high electric fields. These measurements need to be non-destructive and should be able to operate on the commercial scale. The results will help develop computing products based on the principles of functional materials such as piezoelectrics.

Project IND54: Novel electronic devices based on control of strain at the nanoscale

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New communications technologies

Increasing network capacity and quality

Traffic on telecommunication networks is currently growing by around 40 % each year, which will soon lead to a capacity crunch unless new technologies are introduced to maintain quality and prevent disruption to the networks on which the modern world relies.

Technologies such as reconfigurable and multiple antennas can increase the capacity and quality of wireless communications, however they also make testing more complex and time consuming. When building a satellite, antenna testing happens during a high-risk stage of development, therefore more complicated antennas could potentially disrupt the already tight delivery schedules satellite companies must adhere to.

This project will support the work of the European Telecommunications Standards Institute (ETSI) and the International Electrotechnical Commission (IEC), and will result in new measurement procedures and services to support the introduction of new multiple antenna systems, satellite system testing and the next generation of optical communications equipment.

Project IND51: Metrology for optical and RF communication systems

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Product appearance

Improving measurements of visual effects

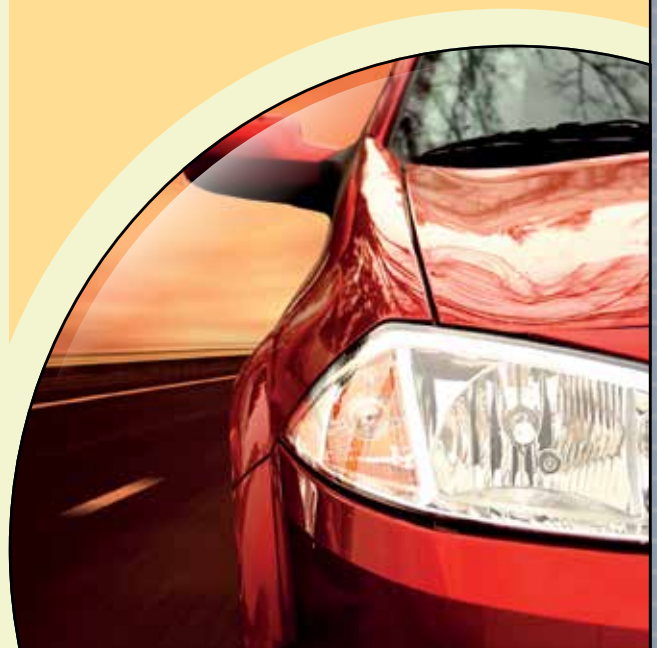
A customer will often choose a product based on the way it looks. Consequently, many industries invest time and money in developing sophisticated visual effects such as metallic paints, sparkle effects and matt finishes.

Visual attributes such as colour, gloss, texture, transparency, graininess and sparkle all combine to give the appearance of a particular surface and this project will focus on making better measurements of this overall appearance, as experienced by a potential customer.

The project will reduce measurement time and uncertainty and strengthen the traceability of measurements of effects such as goniochromatism, gloss and fluorescence. It will consider how different effects combine to produce a final finished appearance, and will relate measurements to the visual sensation of the end-user. This work will benefit quality control, for example when ensuring that different bodywork panels on a car appear similar or that a finished product matches the description or image a customer was given.

Project IND52: Multidimensional reflectometry for industry

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Accurate clocks for industry

Compact, high-performance clocks for commercial environments

Atomic clocks provide accuracy and stability for modern communication and navigation systems. However, the clocks with the highest accuracies are only suitable for use in tightly controlled laboratory conditions. Vapour-cell clocks offer a portable alternative to atomic clocks but have so far only been developed in the laboratory environment.

This project aims to make use of recent advances in, for example, laser technology and techniques to prepare and detect atoms to develop a number of different types of vapour cell clock. These clocks should be small, reliable and energy efficient enough to be used in commercial environments and they could be made to perform up to two orders of magnitude better than current commercial devices.

By providing increased access to accurate time, industries such as navigation, telecommunications, defence and precision instrument manufacturers will benefit from the project.

Project IND55: Compact and high-performing microwave clocks for industrial applications

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Measurements for medical devices

Characterising new biomaterials to improve patient safety

The global medical device industry is worth over 200 billion € annually but, although implanted medical devices improve the quality of life for millions of people, the rates of complications and failures due to incompatibility with human tissues and infection remain unacceptably high.

Surface technologies that could help reduce this failure rate include thin film coatings, surface grafted biomolecules, nanoparticle coatings and drug eluting materials, which slowly release drugs into the body over a period of time. However, these technologies need new measurements to ensure the quality, efficacy and safety of the devices that use them.

This project will develop the chemical measurement tools to characterise advances in biomaterials for the medical device industry. It will bridge the gap between proven laboratory techniques and emerging technologies. The results will help improve patient safety and enable European companies to remain competitive by increasing the quality and reproducibility of their products.

Project IND56: Chemical metrology tools for manufacture of advanced biomaterials in the medical device industry

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projects.npl.co.uk/IND56-Q-AIMDS/



Naturally radioactive material

Keeping radiation out of waste and finished products

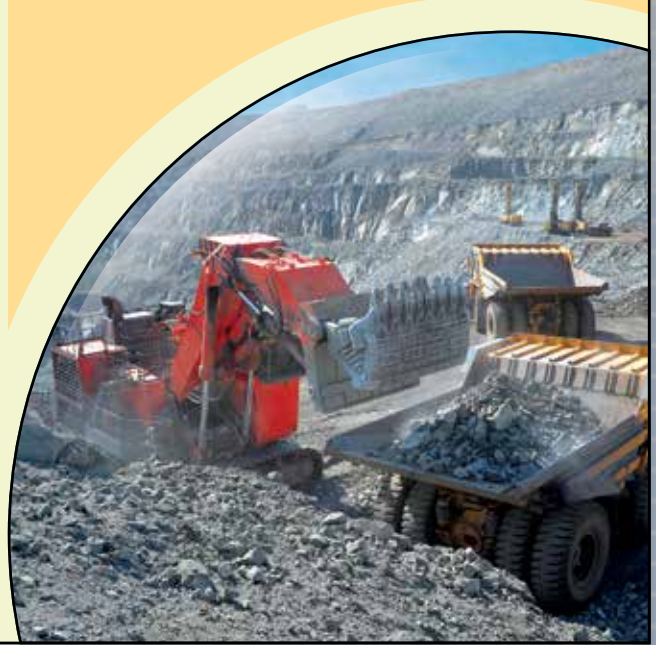
Many natural resources are also naturally radioactive, meaning that the industrial activities that exploit them could also expose people to radiation. Waste constitutes a huge economic and environmental burden, if not properly disposed of, but recycling could result in significant cost savings for the industries that create it.

This project will develop new methods and devices for the measurement of naturally occurring radionuclides as well as new reference materials for their calibration. It will also improve nuclear data so that as many descendants of uranium and thorium decay chains as possible can be accurately measured. The new traceable measurement procedures will be proposed to CEN/CENELEC for standards for industrial raw materials, products and waste.

By providing improved, more reliable and accurate measurements of naturally occurring radionuclides, the project will ensure that, if these raw materials are present in industrial processes, they will not unknowingly enhance radioactivity levels in waste and finished products.

Project IND57: Metrology for processing materials with high natural radioactivity

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Freedom of movement

Measurements for positioning in six degrees of freedom

Mechatronic motion systems are the basis of most production systems, ranging from machines for wafer scanners in semiconductor production, to robotics and coordinate-measuring machines. However, it is difficult to position these systems to the required precision under harsh and changing conditions, and this can lead to a trade-off between fast measurements and accuracy.

This project will develop measurement instruments to support traceable six degrees of freedom (6DoF) measurement. 6DoF refers to the ability of an object to move freely in three-dimensional space.

The project will use interferometry techniques to establish a direct link to the definition of the metre. Traceable measurements of position, angle and straightness will be made accurate to the nanometre. Novel hardware and improved sensor systems will improve nano-positioning. This will benefit industry through more efficient production processes, reducing the number of defective parts and this will lead to savings in raw materials and time.

Project IND58: Metrology for movement and positioning in six degrees of freedom

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Measurements for microparts

Measuring small, complex features in three dimensions

Microparts are components which range in size from less than one millimetre to around 10 mm. Microparts with complex geometry are increasingly used for products in the automotive, medical and telecommunications industries. In many cases the complete inner and outer shape of the microparts must be verified in order to ensure they function correctly.

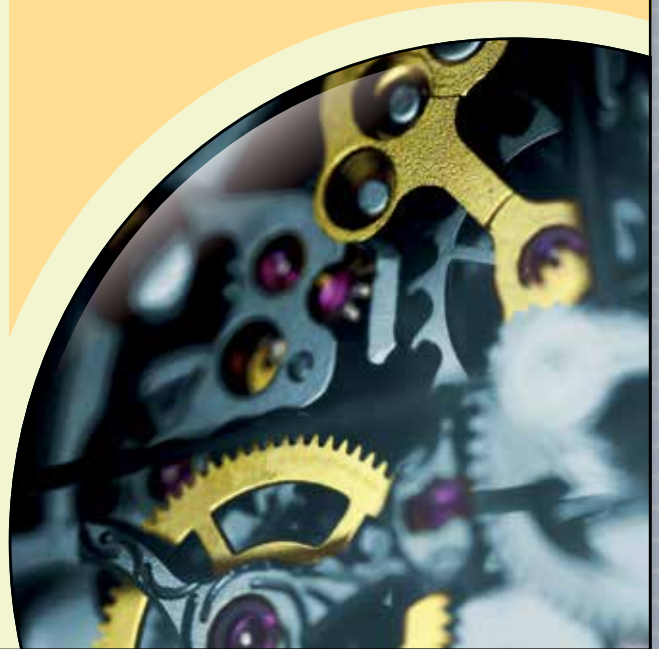
Multi-sensor coordinate metrology combines the speed of optical measurements with the accuracy of tactile systems. However, work is required to achieve 3D measurements of microparts less than one millimetre in size, with sub-micrometre tolerances. In addition, combining measurements from multiple sensors requires intelligent data processing.

This project will address the problems related to the high-accuracy measurement of small complex features of microparts. This will support many industrial applications such as the production of more efficient combustion engines, improved consumer electronics and new medical products such as portable diagnostics.

Project IND59: Multi-sensor metrology for microparts in innovative industrial products

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Preventing electromagnetic interference

Improved testing for electronic products

Electronic products must comply with Electromagnetic Compatibility (EMC) standards to ensure that they do not cause, and are not adversely affected by, electromagnetic interference. However, this requires measurement and validation when a product is being developed, which can be costly and time consuming for the manufacturer.

The required measurements can be adapted to reduce the time and cost involved, but not enough is known about the performance, characterisation, validation and traceability of the adapted techniques. Furthermore, there are few existing standards that detail the EMC testing of large equipment and even in these there are gaps in information.

This project will fill these gaps in the EMC testing of large equipment and help companies evaluate their products while they design them, in order to identify and solve any problems early on in the development process. The project will also investigate the adaption of standard methods and correlate the performance and uncertainty of new methods against the standard tests.

Project IND60: Improved EMC test methods in industrial environments

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www.emc-industry.com



High temperature erosion testing

Saving high value components from high temperature wear

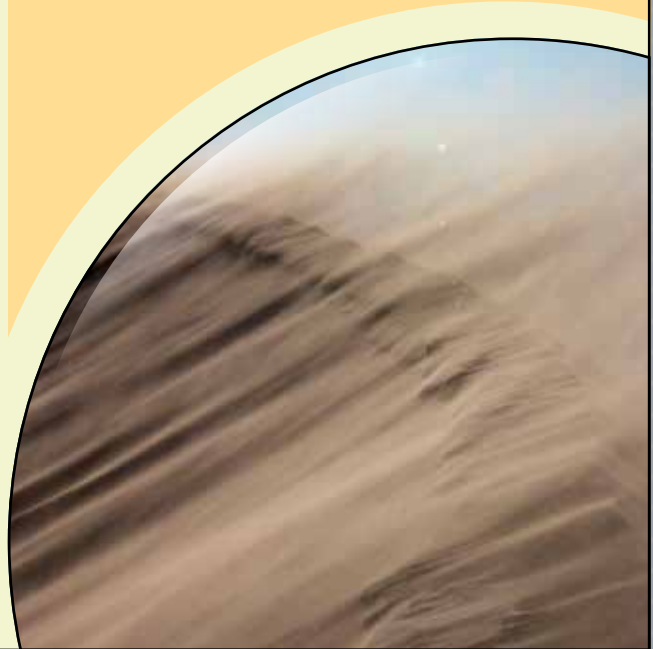
Erosion issues are recurrent problems for gas turbines operating in desert environments. Erosion and wear can dramatically reduce the efficiency and lifetime of high value components, which currently costs the power industry an estimated 200 million € each year in lost performance, forced outages and repairs. Efficiency improvements of up to 10 % could be made by developing new materials with improved resistance to high temperature particulate erosion. However, few facilities exist to measure this erosion around the world and those that do are limited in terms of particle speed and temperature.

This project will build a system to perform tests at temperatures up to 900 °C and particle speeds up to 300 metres per second. The tests will also use fully characterised particles in terms of their size, shape and distribution, to give greater control and precision. This will support the development of new materials with improved resistance to erosion, leading to improvements in the aerospace, energy, mining and oil and gas industries.

Project IND61: Metrology to enable high temperature erosion testing

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Measurements during production

Verifying in-process machine tool measurements

Vibration, noise, sound and light can all affect the accuracy of measurements made during the manufacturing process. In addition, the force and load placed on machines generates heat, preventing traceable and reliable measurement.

Existing machine tool calibration techniques are not able to characterise and mitigate against the in-process effects. A lack of suitable procedures to assess the uncertainty of dimensional measurements on machine tools also makes it impossible to rely on in-process measurement results, leading to long production downtimes and high manufacturing costs. Laser-based techniques offer an alternative solution but they do not currently account for all the possible measurement errors.

This project will develop a portable test chamber that can simulate environmental in-process conditions and verify the measurement performance of machine tools in situ. The resulting traceable in-process dimensional measurements will offer better product quality control, lower manufacturing costs, higher productivity and faster assessment of product quality.

Project IND62: Traceable in-process dimensional measurement

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Atmospheric control in sensitive manufacturing environments

Monitoring airborne molecules to prevent contamination

The ability to operate at smaller scales brings with it technical progress but also a need for tighter control of manufacturing environments. Airborne molecular contamination in the form of vapours or aerosols can have adverse effects on small scale products, processes or instruments and this can lead to the corrosion of metal surfaces or to the formation of contamination layers. This is a particular problem in the semiconductor, nanotechnology, photovoltaic and LED industries.

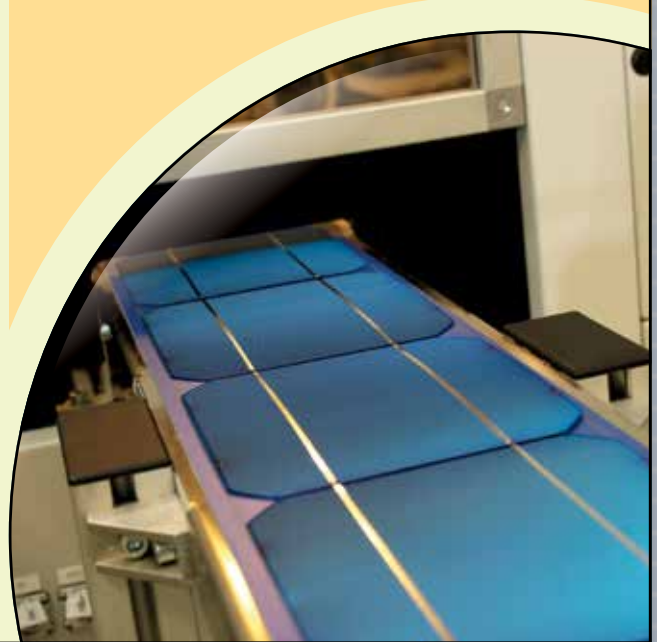
These industries demand continuous measurement and control of airborne molecules to optimise production processes, particularly when taking new techniques to smaller scales. The main sources of contamination are the chemicals used during manufacturing such as acids, bases, dopants and metals, some of which require detection at the parts per billion level.

This project will use state-of-the-art techniques for practical airborne molecular contamination monitoring to develop portable ultra-sensitive monitoring equipment for use in manufacturing environments. It will also develop new material generation methods to help reliably calibrate industrial equipment.

Project IND63: Metrology for airborne molecular contamination in manufacturing environments

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Europe's National Measurement Institutes working together

The majority of European countries have a National Measurement Institute (NMI) that ensures national measurement standards are consistent and comparable to international standards. They also investigate new and improved ways to measure, in response to the changing demands of the world. It makes sense for these NMIs to collaborate with one another, and the European Association of National Metrology Institutes (EURAMET) is the body that coordinates collaborative activities in Europe.

EURAMET has implemented the European Metrology Research Programme (EMRP), a project programme organised by 23 NMIs and supported by the European Union, which will have a value of over 400 M€. The EMRP facilitates the formation of joint research projects between different NMIs and other organisations, including businesses, industry and universities. This accelerates innovation in areas where shared resources and decision-making processes are desirable because of economic factors and the distribution of expertise across countries or industrial sectors.

EURAMET wants to involve European industry and universities at all stages of the programme, from proposing Potential Research Topics to hosting researchers funded by grants to accelerate the adoption of the outputs of the projects.

Full details can be found at: www.euramet.org

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EMRP

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