Publishable JRP Summary Report for JRP IND 09 (Dynamic)
Traceable Dynamic Measurement of Mechanical Quantities

Summary of the JRP

The aim of this project is to establish traceability for the three mechanical quantities force, torque and pressure for measurements under dynamic conditions. The required research carried out in this JRP will provide the foundation for a European infrastructure for traceable dynamic measurements of these mechanical quantities.

Traceable dynamic measurement of these core mechanical quantities is currently not possible and corresponding research has therefore been addressed as an important topic in the EMRP Outline 2008. Lack of traceability currently prevents industry from making reliable measurements in a range of applications with consequences for safety, quality and efficiency of designed systems. Reliable traceable dynamic measurements would also greatly reduce development efforts and costs, thereby significantly reducing required resources. The support received from various stakeholders like automotive companies, OEM for measurement and testing equipment, service providers for accredited calibration or standardization organizations also clearly demonstrates the benefits they and other European industrial stakeholders will obtain from successful completion of this JRP.

At present traceability only exists for static realisations of the mechanical quantities force, torque and pressure. The traceability is established through validated primary calibration devices together with a standardized uncertainty evaluation provided by the Guide to the Expression of Uncertainty in Measurement (GUM). The problems that this project is designed to address arise in dynamic measurements, i.e., those applications in which the frequency-dependent response of a sensor cannot be described satisfactorily by a single parameter (sensitivity) from static calibration. In these cases there will be a need to correct the measurement data for these limitations. This requires that a dynamic model for the system be established through a dynamic calibration.

Primary calibration devices will be developed and validated for force, pressure and torque. The calibration devices will utilize sinusoidal and shock excitations. Based on the frequency response parametric dynamic models will be established for the systems which then provide the traceability for subsequent dynamic measurements.

The GUM does not yet account for dynamic measurements. To achieve traceability in such cases, statistical methods for the evaluation of uncertainties will be developed which address system identification as well as input estimation, and which are consistent with those employed in the static case.

The existing facilities available at the national metrology institutes (NMI) participating in this JRP and their wide experience in static calibration reduce greatly the risks associated with this project. The expertise in the consortium encompasses the experimental, mathematical and statistical proficiency required for an interdisciplinary project such as this. The partners have also proved their suitability for this challenging research by successfully establishing traceable dynamic measurements of the mechanical quantity acceleration including the industrial application level.

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

Expected Impact of the Project

A successful implementation of this JRP will foster key European industry. For example, dynamic measurements of force, pressure and torque are highly important for the automotive sector on which about 12 million jobs depend throughout Europe. As automobile use contributes greatly to CO2 emissions, future improvements made possible through this JRP will also help reduce carbon emissions.

Dynamic measurements and generation of precise dynamic mechanical test signals are a prerequisite for reliable testing and hence it will be possible to improve the safety of many systems. In addition areas of (metrological) research such as material testing will substantially benefit from the possibility of traceable dynamic measurements of force, pressure and torque. It will be easier for European manufacturers of sensors and instrumentation for dynamic mechanical applications to demonstrate product compliance with global standards and customer requirements following the completion of this JRP.

The NMI and stakeholders participating in this project will benefit directly. NMI will be able to provide new primary dynamic calibration services. The industrial stakeholders will employ the results for their development of new transducers or commercial calibration systems specifically designed for dynamic calibration.

Research in the direction of this JRP is currently under way world-wide, and this JRP will help to strengthen the European position.

Report Status: PU Public

JRP start date and duration: 06/2011 3 Years

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