Request for Use Cases

The Expert Group of the CIPM "Digital SI" cordially requests that participants in the workshop submit brief use cases describing situations where machine readable and actionable representations of measurement data with (SI) units of measure are important for clear and unambiguous understanding of data. These can be drawn from any area of metrology or supporting research, or from more general problems regarding clear communication of units. Some examples are given below.

Please submit your suggestions to robert.hanisch@nist.gov **by 17 February 2021** so that the Expert Group has time to collate them for discussion at the workshop.

A vision statement on the future development of digital data based on the SI (SI Digital Framework) is available at the workshop webpage for further information.

Thank you!

Robert Hanisch, Daniel Hutzschenreuter, and Blair Hall, for the Expert Group.

Materials Science

A pressing challenge in materials science concerns microstructures, i.e., the arrangement of the constituents of a material (alloy, polymer, etc.) at the atomic scale. Microstructure properties such as grain size distribution and grain boundaries have a profound impact on the macro-scale properties of the material (stiffness, flexibility, brittleness). Microstructure images are made with various types of electron microscopy, and in order to study microstructures and how they correlate with overall material properties one would like to aggregate data from multiple experiments and expose the images to machine learning algorithms. The metadata describing the images will include information such as pixel size and electron beam energy, but there is no guarantee that they will be in the same units. Being able to dynamically parse a digital representation of units and convert to a common representation would demonstrate the power of a widely agreed Digital SI and its importance for unambiguous and reproducible science.

Digital Calibration Certificates

Calibration of measuring instruments and artefacts is one of the pillars of the quality infrastructure. Through an unbroken chain of calibration, products and measurement capabilities of end-users are metrologically traceable to internationally approved units of measure—the SI—thereby facilitating global trade, manufacturing, and many fields of science.

Today, we can observe the digital transformation in calibration. More instruments include digital components and Digital Calibration Certificates (DCCs) are changing the reporting and exchange of human-readable calibration data towards full machine-readable formats. The DCCs will help autonomous manufacturing and processing to develop its full power through a link to metrological traceability at the point of measurement. Applications will search data in DCCs to uncover properties of measuring instruments that are hard to access in human-readable formats today and will improve measurements and production in future. At the beginning, DCCs will profit from a SI Digital Framework with international agreed data models for quantity and unit of measurement representation that is ready for interoperation, re-use, and automated data analysis. In the longer term, the capabilities of DCCs in digital applications will increase through enhancing data with machine-interpretable metadata on calibration methods, data evaluation methods, provenance through links to data bases like the BIPM CMC list and a more transparent data life-cycle.

International Aviation

International airline pilots deal with different units, depending on where in the world they fly and what is being measured. For example, in describing length: altitude may be reported in feet or metres, distance in nautical miles, and different units again may be used for the length of a runway (feet or metres) or a measure of visibility (US statute miles or metres). Information about magnitudes can be communicated to pilots verbally without mentioning units, which are conventional within regions. Imperial and SI units are both used, in different parts of the world, for temperature, mass and pressure; wind-speed may be measured in knots or metres-per-second. The reasons for this diversity are probably historical, but the situation endures because the industry is cautious about introducing changes. Some instruments are designed to facilitate a change of units during international travel, in other cases the pilot must make the necessary conversions—hopefully without error or misinterpretation!