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## MEASUREMENT *PLUS* OBSERVATION A NEW STRUCTURE IN METROLOGY

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**Abstract:** The diverse fields of customary Metrology reveal dissimilar perceptions concerning the meaning of the classical procedure «measurement» and of the trendy procedure «observation». No integrating consensus for a common source of insight in Metrology is visible yet. The following endeavour shall be a systematic attempt concerning current data and information gathering tasks and structures. It will propose and develop a self-evident definition of the combination of both procedures in Metrology, "measurement *plus* observation", and will reveal their stringent logical and analytical relationships. Reasonably, dynamic systems and subsystems can model and visualise this structurally demanding result within Signal and System Theory best. The complementary tasks of measurement *plus* observation constitute a modern, consistent, and extended version of the basic metrological structures and needs. This quantitative approach, supported by elucidating Signal Relation Diagrams, is quite new. In order to avoid useless discussions concerning contradictory terms, one should use the term «metrological observation» in case of doubt.

**Keywords:** metrology, measurement, observation, sensor, reconstruction, simulation, estimation, filtering

### 1. INTRODUCTION

The procedure *measurement* is not the only source of a quantitative perception and of a production of data and information in *Metrology*. We are familiar with other, but strongly related principles like observing, acquiring, collecting, monitoring, testing, inspecting, calibrating, identifying, surveying, simulating, estimating, diagnosing, predicting, inferring, perceiving, experiencing, and so on. Finally, they all lead to meaningful and trustworthy metrological results.

The following presentation concentrates on the two most notable terms, *measurement* and *observation*, which are our main interactions with the real world, and our source of data and information, as well as of understanding and knowledge. And both terms serve as representations of the real world. This joint task within Metrology will be the main issue here.

As usual, we feel an urgent need for a common language in this field of interest; however, it exists only rudimentarily. As an attempt in the direction of a unification, please find subsumed some *Terms* and *Symbols* in the Appendix. It is obvious that some of them may carry a slightly different or even controversial meaning than usual.

#### 1.1 Metrological Measurement

The *measurement discipline* of Metrology is of enormous importance. Few people are aware of this fact, as *measurement procedures* serve most discreetly, but effectively, in the background. Moreover, it is almost impossible to consistently sketch and analyse its supporting influence on the wide array of disciplines like for example science, technology, medicine, economy, finance, sociology and so on.

*Measurement processes* use sensoric sub-processes (Figure 1) in order to, hopefully, acquire objective, quantitative, and accurate *data* and *information* about properly defined *quantities*. They establish physical interactions within the real world, and are the main components in the so-called measurement domain.



Figure 1. Measurement Process:

Determination of the Quantity Blood Pressure by Sensoric Subprocesses (© dreamstime)

Note that there are *sensor processes* in other fields too: For example persons, who focus on sociological investigations or even biological cells, which perceive abnormalities in organisms. Sensor processes in the natural world, including humans with their sensory perception of course, are always essential constituents in Metrology. However, difficulties tend to come up with proper definitions of the quantities of interest.

#### 1.2 Metrological Observation

The *observation discipline* of Metrology is not as manifest and tangible, although everybody believes that he knows, what observing aims at: any active acquisition of any type of data and information. That's what the famous newspaper

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