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The Significance of the Entropic Linkage in the Theory of Measurements

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Abstract. This paper deals with the mathematical description of the statistical linkage between the probability systems from point of view of measurement theory. It is shown that a suitable measure for the statistical linkage represents the amount of information contained in the random variable defined on the pointer positions of measuring instrument about the measured random variable defined on the set of physical states of measured object. The information becomes so a physical quantity that expresses the magnitude of so-called entropic linkage between the physical probability systems representing, in frame of entropic model of measurement, the measured object and measuring instrument. Physical aspects and the mathematical properties of the measure for the entropic linkage between the measured object and measuring instrument are treated in this paper. To illustrate an application of described formalism, a calculation is presented in which the magnitude of Gaussian entropic linkage between the measured microobject and measuring instrument is determined.

Introduction

In the probability description of physical phenomena new sort of properties of physical statistical systems has been introduced in the physics. These properties are mainly connected with the internal structure of statistical systems, e.g. with the order, the set-up or organisation of its elements. In frame of mathematical description of these properties certain quantitative measures, adequate to the physical and mathematical requirements, were found. Entropy, playing an important rôle in the thermodynamics and statistical physics, belongs to the most important measure for a property of said sort. Precise mathematical definition of the term "entropy" showns that the general entropy can be explicitly determined through the elements of the probability distribution of a random variable defined on a physical probability system. Therefore, the entropy of a random variable may be an adequate measure of its probability uncertainty [1], a concept being introduced and studied in frame of information theory [2]. The connection between the general entropy and physical entropy was found by JAYNES in his principle of the "maximum entropy estimation" well known in the statistical mechanics [3].