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Comparison of the GCV method and a subjective optimality criterion in the problem of determining the velocity of a heavy ion using a semiconductor detector (PIN diode)

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This paper presents a statistical comparison of two methods for determining the velocity of a heavy ion using a semiconductor detector (PIN diode): the method based on a subjective optimization criterion that employs the mathematical formalism of subjective modeling (MFSM) proposed by Yu. P. Pytyev, and the generalized cross-validation (GCV) method. The MFSM makes it possible to formulate mathematically both a subjective model of the object under study and a subjective mathematical model of its measurements and their subjective interpretation. Using the MFSM, one can mathematically formalize the subjective judgments of the researcher-modeler regarding the physical properties of the object under study, the means of its measurement, the mathematical properties of noise, and so on; all such subjective information is based on the researcher-modeler's scientific experience and scientific intuition. The GCV (Generalized Cross-Validation) method is a statistical method used to select the regularization parameter when solving ill-posed problems, smoothing data, or reconstructing signals. GCV helps to efficiently estimate noise and to choose smoothing in problems where direct estimation of parameters is difficult. A computational experiment has been carried out that simulates the acquisition of a signal at the detector with a halved ion registration rate, which makes it possible to assess how sensitive the two compared methods are to the sampling rate of the recording equipment.

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