UNDERSTANDING PHYSICS FROM INTERCONNECTED DATA

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Abstract

Metal melting on release, after explosion, is considered here as an example of a physical system far from equilibrium. The goal is not only to describe and understand this system but also to develop more general methodology to approach similar problems. Due to highly non-equilibrium nature of the process and to simultaneous interconnection of many different physical effects, a complete physical model of the process does not exist. Bayesian and correlation analysis of the data is a step in the direction of building the physical model. Therefore, the ultimate task of this work is to find and utilize all possible dependencies within the system.

Metal melting on release possesses a number of different characteristics, some of which seem to be incompatible with each other. They include time, metal type, thickness of the material, etc. One can see that the problem of finding the physical model of the system is connected to the problem of combining its measurable properties in the case of minimal compatibility. Moreover, some of these characteristics, such as time and thickness, belong to a potentially infinite domain. On the other hand, being able to combine every feature of the system is very important in understanding the underlying physical model.

Another important problem is proper extraction of information from the raw experimental data consisting mainly of a vast amount of noisy and low contrast proton-radiographic images obtained from the experiments. These images are a "gold mine" of the information essential to a specific goal, hence the feature extraction from images is driven by the goal. Parameters like velocity of different parts of the system obtained from the images constitute the system representation. Standard image processing approaches, like gradient based contour detection can not be applied due to insufficient quality of the images. Other methods of contour detection and velocity calculations developed in the project are presented.

References:

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