

PHYSICS EXTRACTION PODS (PEP): AN EVOLUTION OF THE RVE

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ABSTRACT

We construe representative volume elements (RVE) as information processing units capable of arbitrary encoding/decoding tasks. They were originally conceived to encode knowledge gleaned through an averaging process. Generalizations, for example to include structural details, e.g. in the form of fabric tensors, or statistical information, e.g. in the form of statistical RVE, have extended their utility and provide the impetus behind our proposed Physics Extraction Pods (PEP). We conceive of a data acquisition pod, equipped with multi-modal sensors to feel its environment. PEP is also equipped with pre-designed logic to interpret the sensed data and with a decision module to react to these measurements. PEP can be deployed within a purely experimental setting, a purely numerical setting, or a hybrid setting where the pod is in communication, for sensing and decision, with experimental and numerical data.

PEP is equipped to discover locally dominant physical phenomena, thus permitting a novel characterization of heterogeneity. It is also equipped for autonomy, with capabilities for automatic differentiation, design of experiment, and statistical inference.

We demonstrate the versatility and utility of PEP on problems of reactive flow and composite materials.