Persistence Concepts for 2D Skeleton Evolution Analysis

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Abstract In this work, we present concepts for the analysis of the evolution of two-dimensional skeletons. By introducing novel persistence concepts, we are able to reduce typical temporal incoherence, and provide insight in skeleton dynamics. We exemplify our approach by means of a simulation of viscous fingering—a highly-dynamic process whose analysis is a hot topic in porous media research.

1 Introduction

There are many research problems that express themselves rather in terms of topological structure than morphology. Examples of such processes include electrical discharge, growth of crystals, and signal transport. In this abstract, we address so-called viscous fingering, where the interface between two fluids is unstable and develops highly-dynamic "finger-like" structures. A prominent cause for such structures are setups where a fluid with lower viscosity (Fig. 1(a)–(c), left) is injected into a fluid with higher viscosity (Fig. 1(a)–(c), right). A straightforward analysis approach is to extract the topology of each time step independently by means of traditional skeletonization. In our case, we employ iterative thinning [5]. However, this tends to lead to temporally incoherent skeletons because iterative thinning is susceptible to small variations and noise. We present persistence concepts to address these issues and provide insight into the underlying processes.

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