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Operator Scaling Stable Random Sheets with application to binary mixtures

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ABSTRACT: Random fields are useful for modeling events from different subject areas. They are for example used for simulation of natural phenomena in physics, hydrology, or geology. In order to faithfully model these phenomena, the random fields need to have properties often observed in real data and experiments: scaling properties, also known as 'statistical' self-similarity and anisotropy, that is different scaling in different directions. A. Kamont introduced the first example of anisotropic self-similar Gaussian random field, the fractional Brownian sheet (FBS). These fields scale independently and at possible different rates along the coordinate axes. Another concept of anisotropic self-similar random fields are the Operator Scaling Stable Random Fields (OSSRF) introduced by H. Biermé, M. Meerschaert, and H.-P. Scheffler. These random fields have global dependence structures, but the subspaces can not be decoupled as in the case of FBS. The basic idea of this work is to link the concepts of FBS and OSSRF to get a class of random fields, which offers very flexible design possibilities by connecting the characteristics of both concepts. To show the advantage of the combination of these two concepts, we simulate segregation processes driven by our random field which improve previous simulation results using isotropic fields, yielding results close to experimental data.