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Advanced MPS to explore unobserved heterogeneity: Incomplete training images, 2D to 3D, and pattern-to-point data merging.

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In the beginning of the 2000's [1], multiple-point statistics (MPS) was introduced as a novel geostatistical approach to explore the variability of natural phenomena in a realistic way by observing and simulating data patterns, sensibly improving the preservation of connectivity and shape of the modeled structures.

A usual requirement for MPS is the presence of complete and representative training images (TI), showing clear and possibly redundant examples of the studied structures. But in the everyday practice, this information is often partially or scarcely available, strongly limiting the use of MPS.

In this presentation we start with an overview of MPS strategies proposed to overcome training data limitations. We consider different examples of multisite rain-gauge networks containing sparse data gaps, with the goal of estimating the missing data, using the same incomplete dataset as TI [2]. Another considered study case regards the use of 2D training images of geological outcrops used to reconstruct a 3D volume of fluvioglacial deposits [3].

We then consider a common problem in hydroclimatological studies: the bias correction of weather radar images with ground rainfall measurements. This is a typical no-TI problem where there is no example of unbiased grid image to train MPS. In this case, we propose a novel pattern-to-point approach, where we create a catalog of local grid patterns, each one associated to a rainfall measurement. This way the MPS algorithm 1) selects ungauged locations, 2) searches similar grid patterns in the catalog, and 3) projects the linked historical ground measurements at the ungauged locations.

From early results, this technique seems to recover hidden spatial patterns which correct the highly non-linear bias by extracting information from the pattern-to-point catalog. This is a first step for MPS towards the use of TIs integrating variables of different dimensionality, opening a new methodological path for future research.

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