A registration method for Model Order Reduction: data compression and geometry reduction

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In this talk, I present a general — i.e., independent of the underlying equation — registration method for parameterized Model Order Reduction. Given the spatial domain $\Omega \subset \mathbb{R}^d$ and the manifold $\mathcal{M} := \{u_\mu : \mu \in \mathcal{P}\}$ associated with the parameter domain $\mathcal{P} \subset \mathbb{R}^P$ and the parametric field $u : \mathcal{P} \to \mathcal{X}$, $\mathcal{X} \subset L^2(\Omega)$, the algorithm takes as input a set of snapshots $\{u^k\}_{k=1}^{n_{\text{train}}} \subset \mathcal{M}$ and returns a parameter-dependent bijective mapping $\mathbf{\Phi} : \Omega \times \mathcal{P} \to \mathbb{R}^d$: the mapping is designed to make the mapped manifold $\{u_\mu \circ \mathbf{\Phi}_\mu : \mu \in \mathcal{P}\}$ more suited for linear compression methods. I apply the registration procedure, in combination with POD, to devise low-dimensional representations of solution manifolds with slowly-decaying Kolmogorov N-widths; I also consider the application to problems in parameterized geometries.