# Nonlinear dimensionality reduction of parametrized PDEs using deep learning techniques

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We present state-of-art projection-based reduced order models (ROMs) for parametrized PDEs, with special emphasis on the reduced basis method for nonlinear time-dependent problems. We propose new strategies to construct ROMs exploiting deep learning techniques, such as convolutional neural networks. Both the construction of a reduced-order space and the solution of the resulting reduced-order problem can be designed by exploiting neural networks for the sake of computational efficiency. Applications of interest deal with problems featuring highly nonlinear solution manifolds, as well as strong dependence of the solution on parameters, and requiring higher spatio-temporal accuracy; a relevant example is provided by coupled problems related with cardiac electrophysiology, whose goal is modeling the propagation of electric potentials in the cardiac muscle. In this case, suitable combinations of (physics-based) projection-based ROMs and (data-driven) deep/machine learning techniques can provide remarkable computational savings without affecting numerical accuracy substantially.