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On the use of Convolutional Neural Network to accelerate isogeometric analysis

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Isogeometric analysis [1] is the use of traditional computer-aided design (CAD) tools for finite element methods (FEM). In particular B-splines and NURBS are used to form a basis for test- and trial spaces when posing a Galerkin problem in FEM.

Recent years have seen a resurgence of machine learning and artificial intelligence research. The use of convolutional neural networks (CNN) have proven to have remarkable accuracies in classification- and regression problems. For our work we will present the use of convolutional neural network as an accelerator [2] for isogeometric analysis. We propose to train the model in an offline stage on multiple finite element computations to create a solver which can approximate solution fields in a real-time environment.

The use of Convolutional Neural Networks has a number of immediately relevant properties such as the tensor product structure of the underlying data. This allows for most isogeometric solvers to fit into the framework without the need for adaptation. We can thus take advantage of state-of-the-art software and hardware products which are optimized for image processing. We will discuss the limitations and advantages that this approach will give.

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