

A Deep Learning Based Method for Faster 3D Structural Topology Optimization

Authors : Arya Prakash Padhi, Anupam Chakrabarti, Rajib Chowdhury

Abstract : Topology or layout optimization often gives better performing economic structures and is very helpful in the conceptual design phase. But traditionally it is being done in finite element-based optimization schemes which, although gives a good result, is very time-consuming especially in 3D structures. Among other alternatives machine learning, especially deep learning-based methods, have a very good potential in resolving this computational issue. Here convolutional neural network (3D-CNN) based variational auto encoder (VAE) is trained using a dataset generated from commercially available topology optimization code ABAQUS Tosca using solid isotropic material with penalization (SIMP) method for compliance minimization. The encoded data in latent space is then fed to a 3D generative adversarial network (3D-GAN) to generate the outcome in 64x64x64 size. Here the network consists of 3D volumetric CNN with rectified linear unit (ReLU) activation in between and sigmoid activation in the end. The proposed network is seen to provide almost optimal results with significantly reduced computational time, as there is no iteration involved.

Keywords : 3D generative adversarial network, deep learning, structural topology optimization, variational auto encoder

Conference Title : ICSOT 2019 : International Conference on Structural Optimization and Technology

Conference Location : Rome, Italy

Conference Dates : December 12-13, 2019