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Convolutional Autoencoder based Prediction of Ditching Loads with Disentangled Latent Space

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Abstract

Autoencoders are frequently used for dimension reduction in data-driven surrogate models. However, compared to classical methods such as the proper orthogonal decomposition (POD), they generally lack interpretability. More interpretability in autoencoder based surrogate models can be gained by the enforcement of disentangled latent variables, using, e.g., a β-variational autoencoder (β-VAE) [1]. Still, training the β-VAE can be challenging as optimal values for β are often not known beforehand. We compare the probabilistic (convolutional) β-VAE framework with deterministic convolutional autoencoder (CAE) approaches that aim to construct a disentangled latent space with a modified loss function.

The included applications refer to an established periodic flow example and an aircraft ditching test case using the fuselage of a DLR-D150 aircraft. In previous work, combinations of CAE and LSTM networks were successfully applied for the transient prediction of ditching loads [2]. The focus of this presentation lies on the interpretability of the CAE-based approaches, particularly by enforcing a disentangled latent space, and the analysis of the resulting latent variables.

Keywords: convolutional autoencoder, aircraft ditching, disentangled latent space

References

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