ModelFLOWs APP

MODAL DECOMPOSITION

Pattern detection	Reconstruction	Prediction
HOSVD	Data Repairing	HODMD
HODMD	Superresolution	

DEEP LEARNING

Pattern detection	Reconstruction	Prediction
Autoencoders	Superresolution	Full DL
		Hybrid

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Motivation

Autoencoders

Extraction and analysis of flow features in planar synthetic jets using different machine learning techniques

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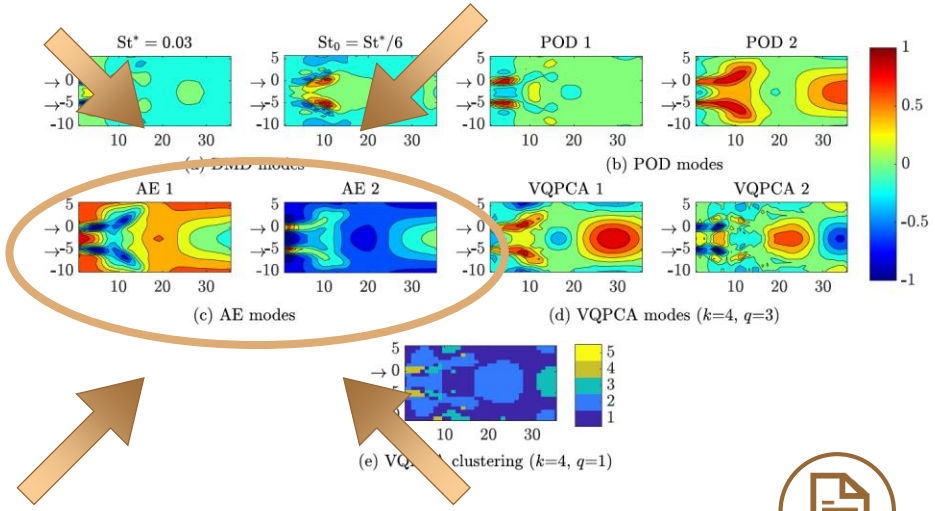
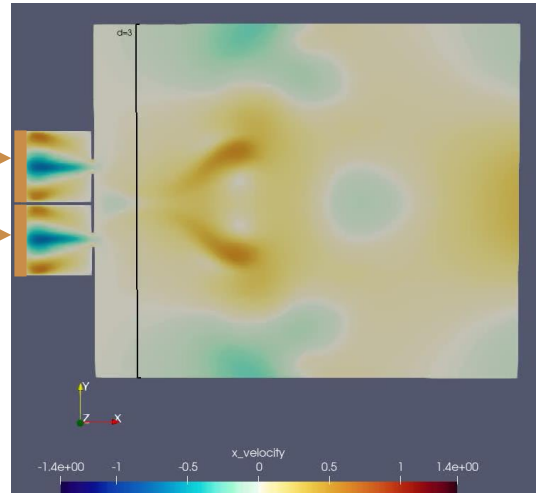


Two planar synthetic jets

Membrane or piston



(Muñoz & Le Clainche, 2022)

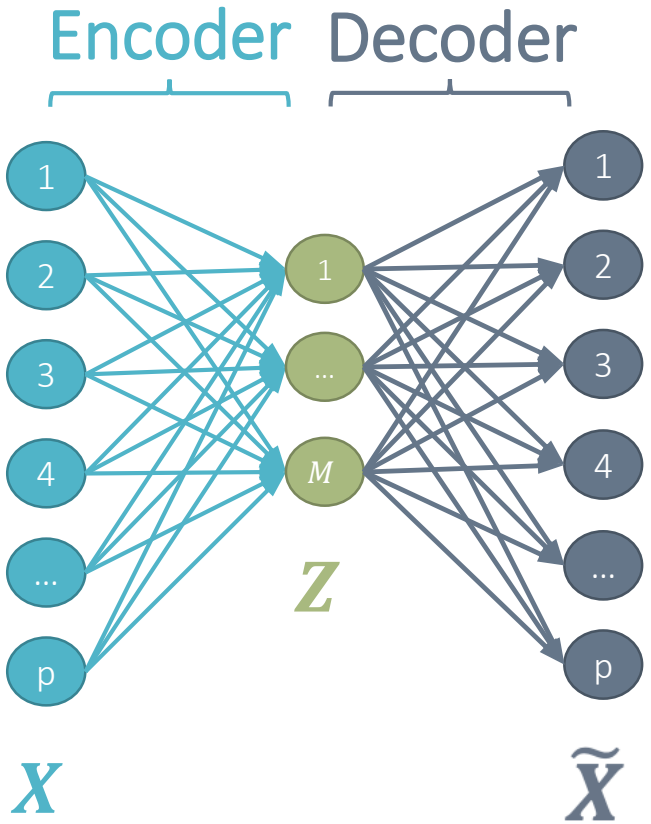
Periodical movement:

- Injection phase
- Suction phase

ModelFLOWs

Methodology

Autoencoders



Autoencoder is a Deep Neural Network (DNN) that provides unsupervised feature extraction

X = Input

Z = Compressed data

$\tilde{X}$ = Reconstructed input

Database & Data preparation

Autoencoders

Spatial dimensions

Snapshots Tensor = $\{N_v, N_y, N_x, N_t\}$

Variables

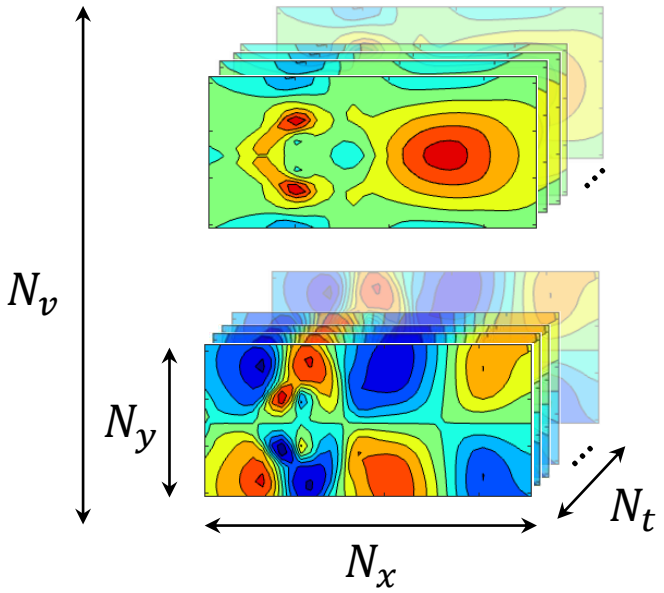
Temporal dimensions

Matrix = $\{N_v N_x N_y, N_t\}$

p

Spatial Dimensionality

Temporal



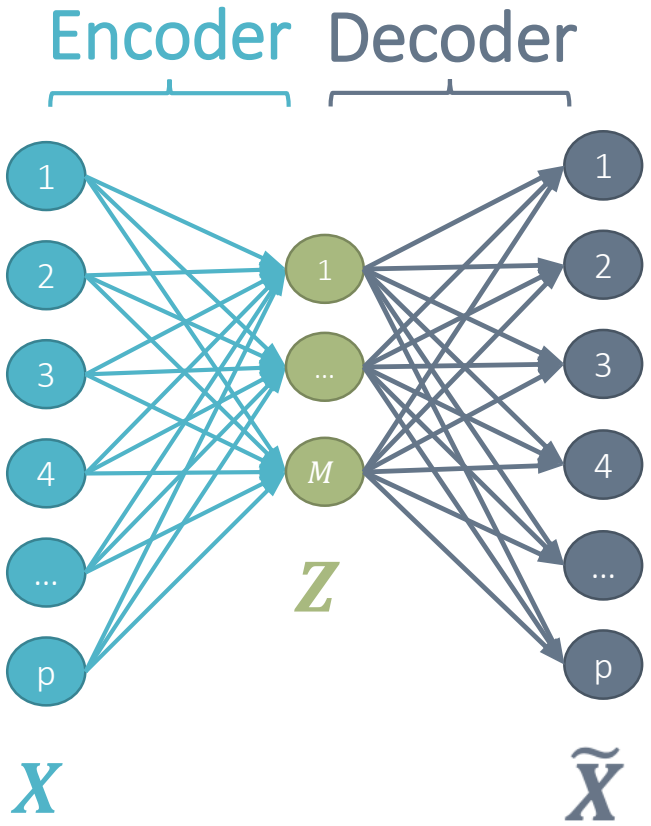
- $N_v = 2$
- $N_x = 45$
- $N_y = 22$
- $N_t = 4369$

Spatial dimensionality = 1980

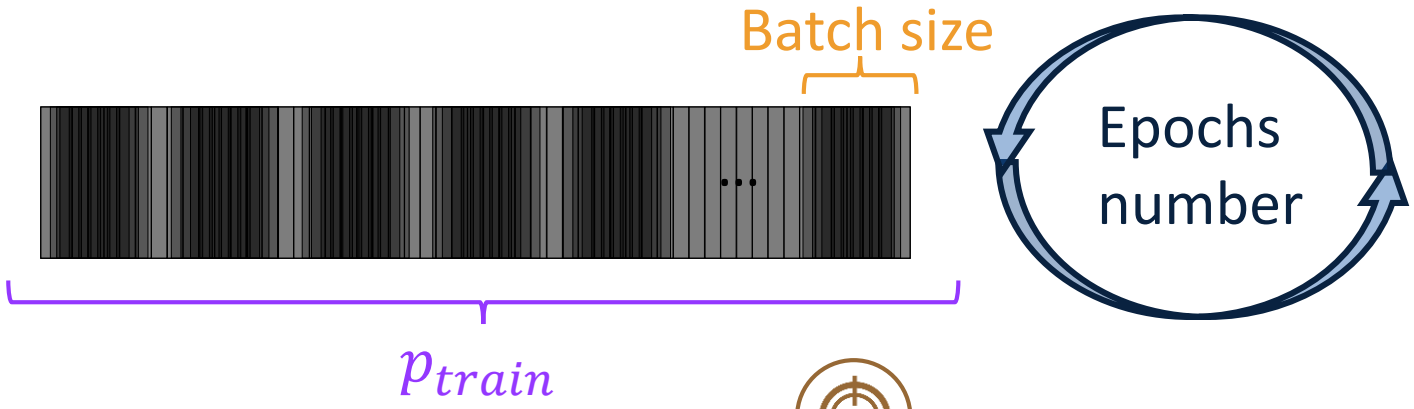
Temporal dimensionality = 4369 p

Calibration

Autoencoders

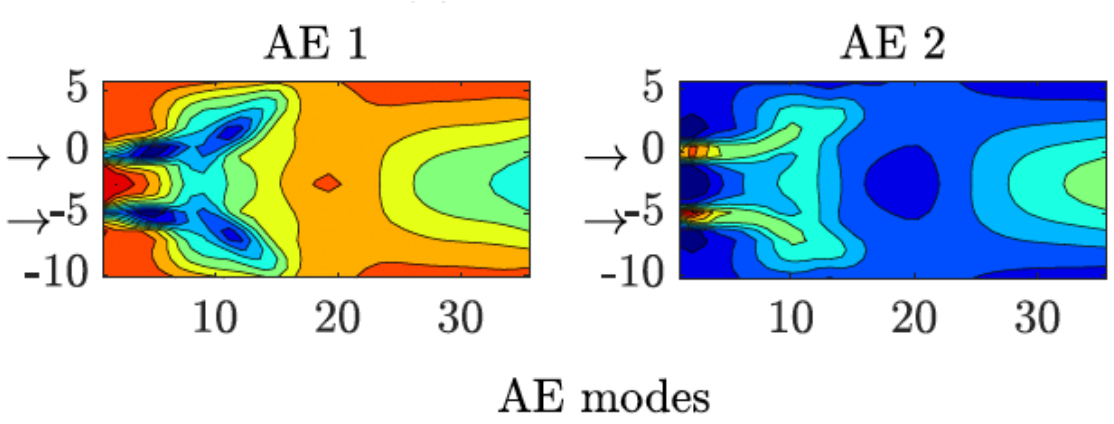


Hyperparameters		Restrictions	Recommendations
Training size	p_{train}	$\leq 80\ \% p$	$\leq 80\ \%$
Number of modes	M	$< p_{train}$	~10
Batch size	N_{batch}	$< p_{train}$	$32, 64, 128, \ldots$
Epochs number	N_{epoch}	–	$100, 200, 500, \ldots$

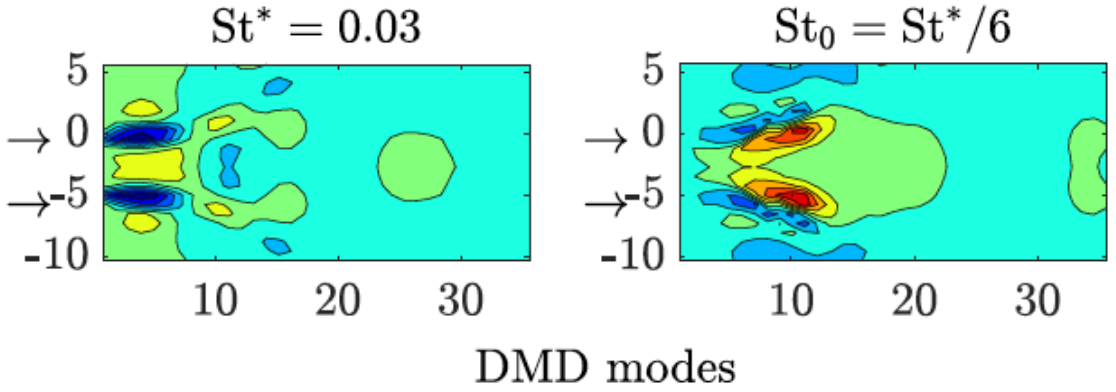


Results

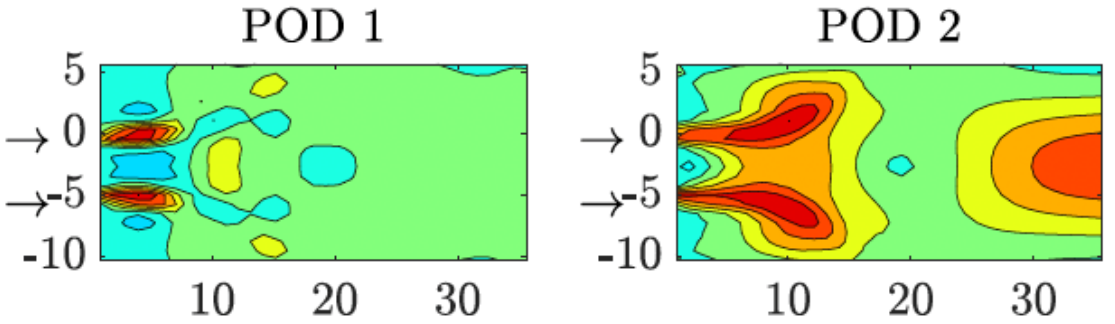
Autoencoders



AE modes



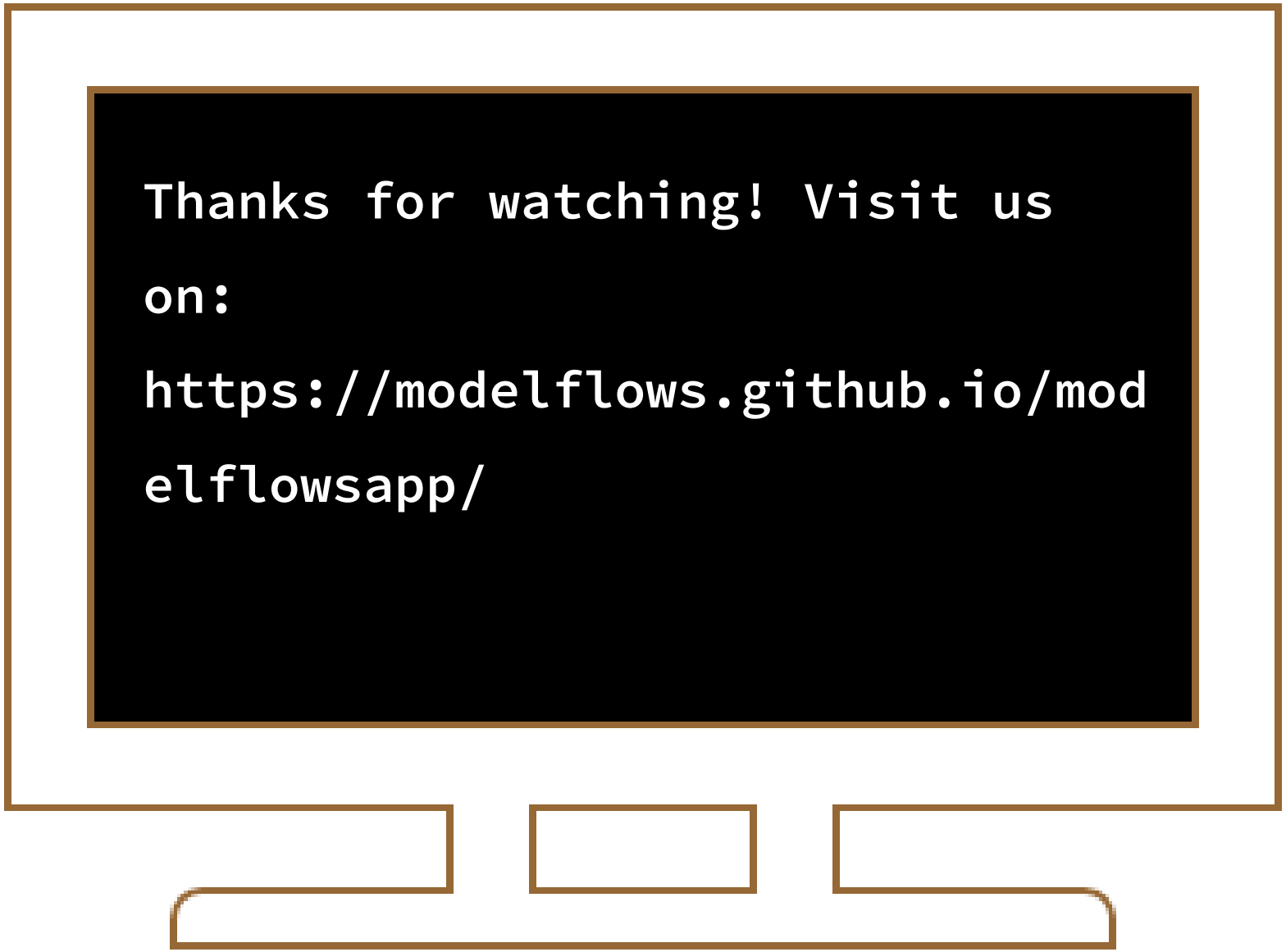
DMD modes



POD modes

Click here for more information

Also compared with local PCA clustering technique (VQPCA)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