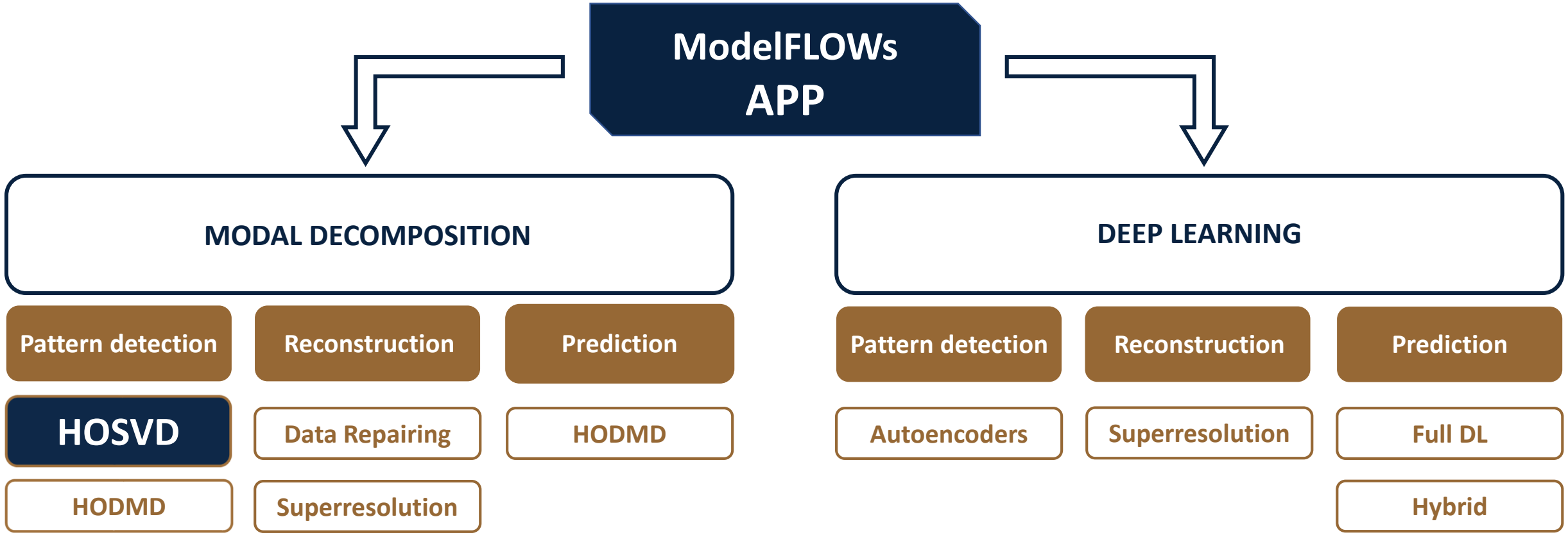
ModelFLOWs APP

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

HOSVD

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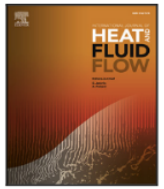

Data-driven assessment of arch vortices in simplified urban flows

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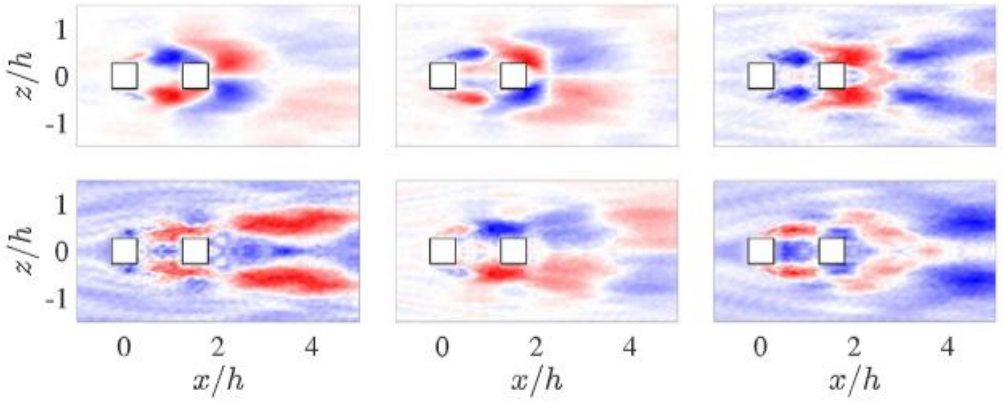


Pattern analysis in turbulent complex flows in urban environments using proper orthogonal decomposition (POD).

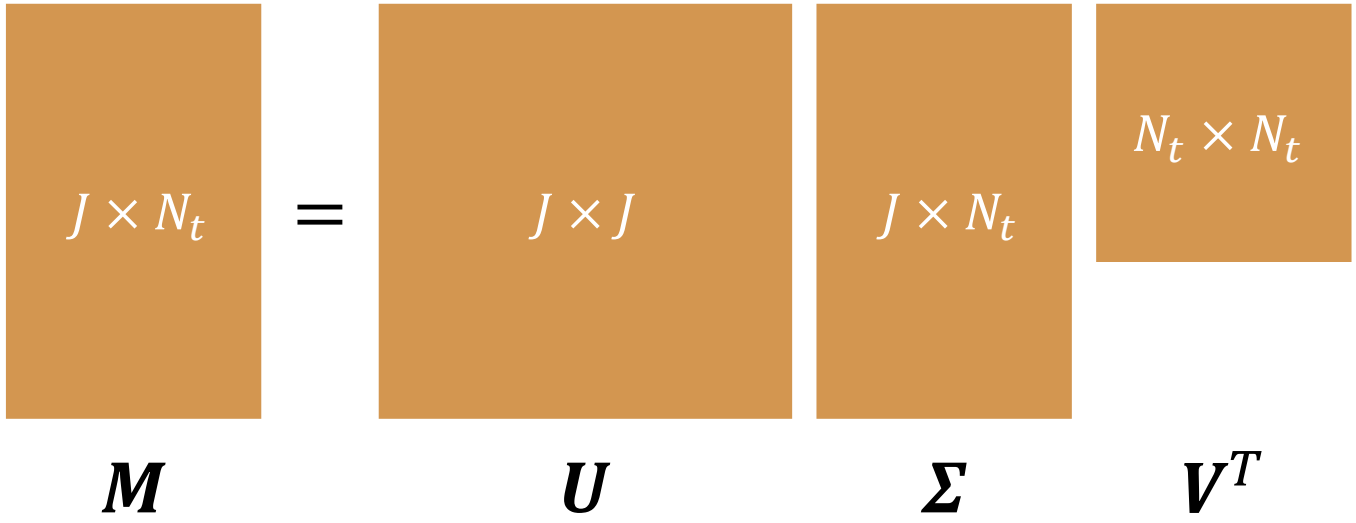
ModelFLOWs

Methodology

HOSVD

$$\boldsymbol{M} = \boldsymbol{U}\boldsymbol{\Sigma}\boldsymbol{V}^T$$

Spatial dimension: $J \equiv N_u \times N_x \times N_y \times N_z$
Temporal dimension: N_t

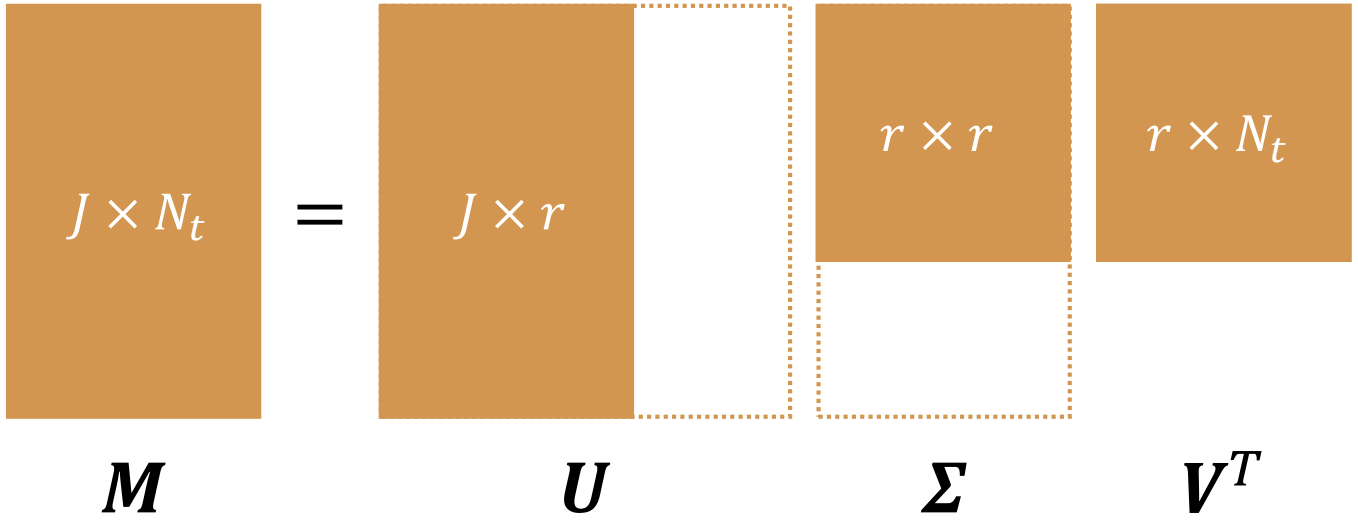


Methodology

HOSVD

$$\boldsymbol{M} = \boldsymbol{U}\boldsymbol{\Sigma}\boldsymbol{V}^T$$

Spatial dimension: $J \equiv N_u \times N_x \times N_y \times N_z$
Temporal dimension: N_t
Rank: $r \leq \min(J, N_t)$

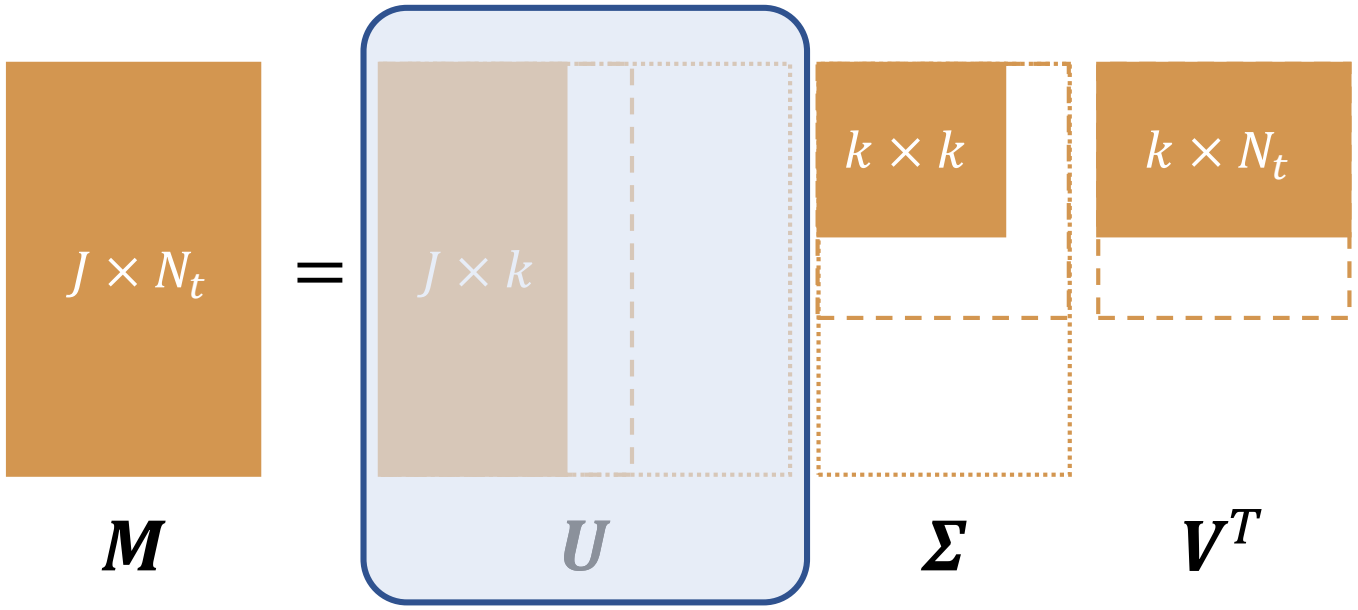


Methodology

HOSVD

Spatial dimension: $J \equiv N_u \times N_x \times N_y \times N_z$
Temporal dimension: N_t
Rank: $r \leq \min(J, N_t)$
Reduce data dimensionality: k

$$\boldsymbol{M} = \boldsymbol{U}\boldsymbol{\Sigma}\boldsymbol{V}^T$$

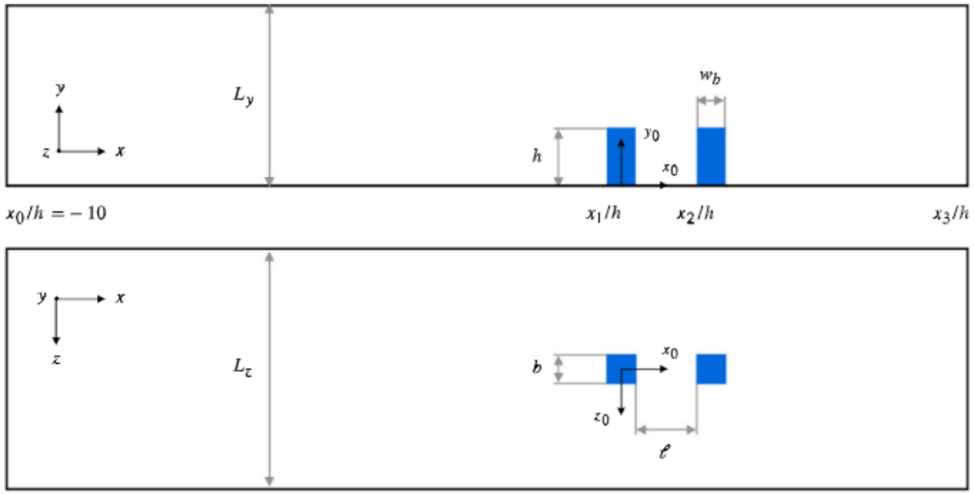


POD modes

Identify spatial patterns

Database & Data preparation

HOSVD



Spatial dimensions

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

Variables

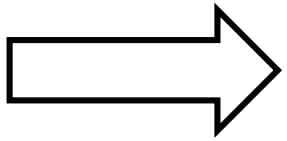
Temporal dimensions

Database & Data preparation

HOSVD

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

- $N_v = 3$
- $N_x = 100$
- $N_y = 125$
- $N_z = 50$
- $N_t = 224$



Spatial dimension = 1875000

Temporal dimension = 224

Calibration

HOSVD

Spatial dimension = 1875000

Temporal dimension = 224

Tolerance SVD: The energy amplitude where we cut the spectrum.

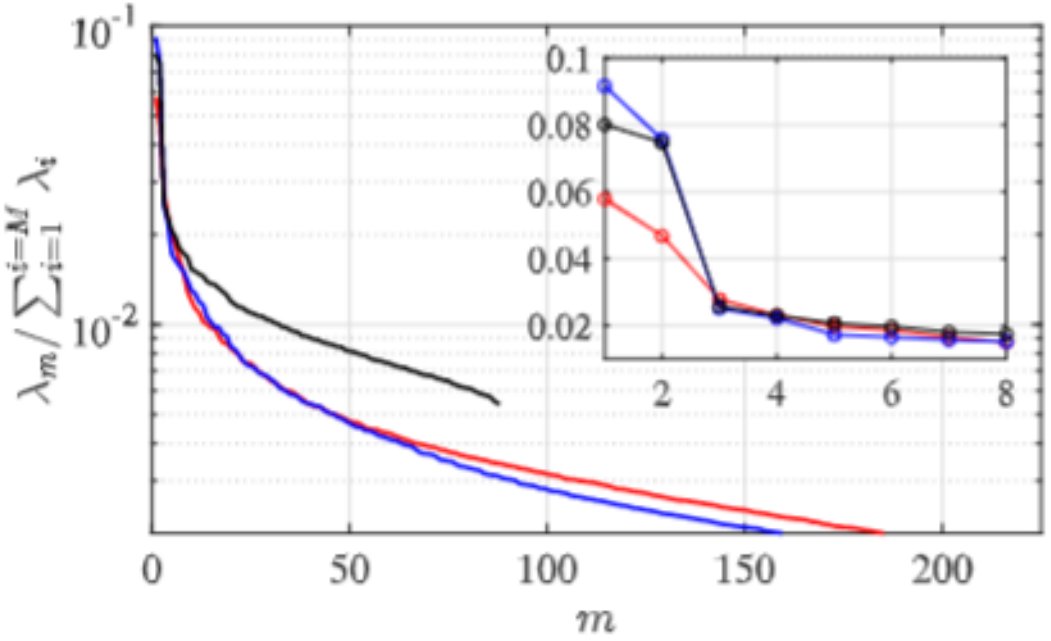
Values: 1e-2, 1e-3, 1e-4

Calibration

HOSVD

Tolerance SVD:

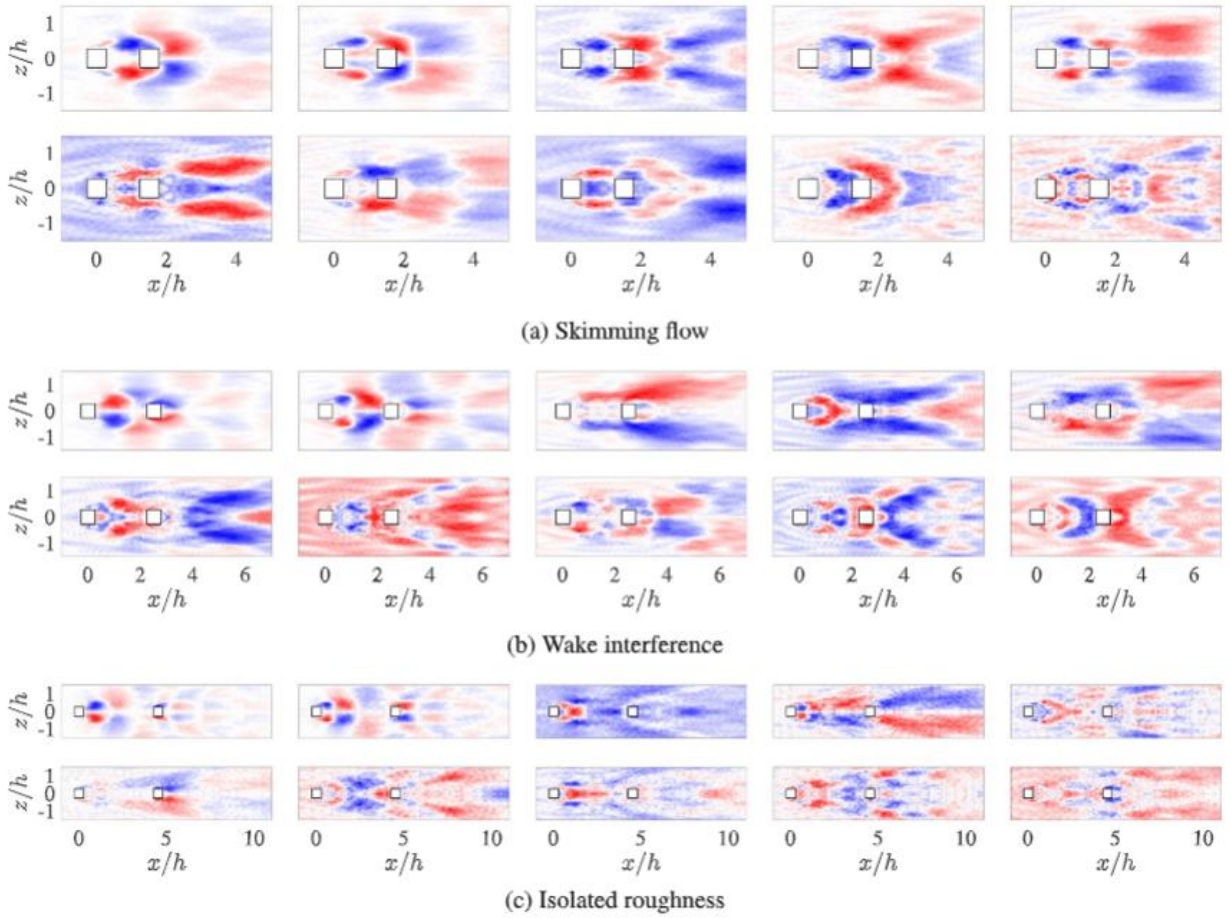
Values: 1e-2, 1e-3, 1e-4



Mode energy decay spectrum

Results

HOSVD



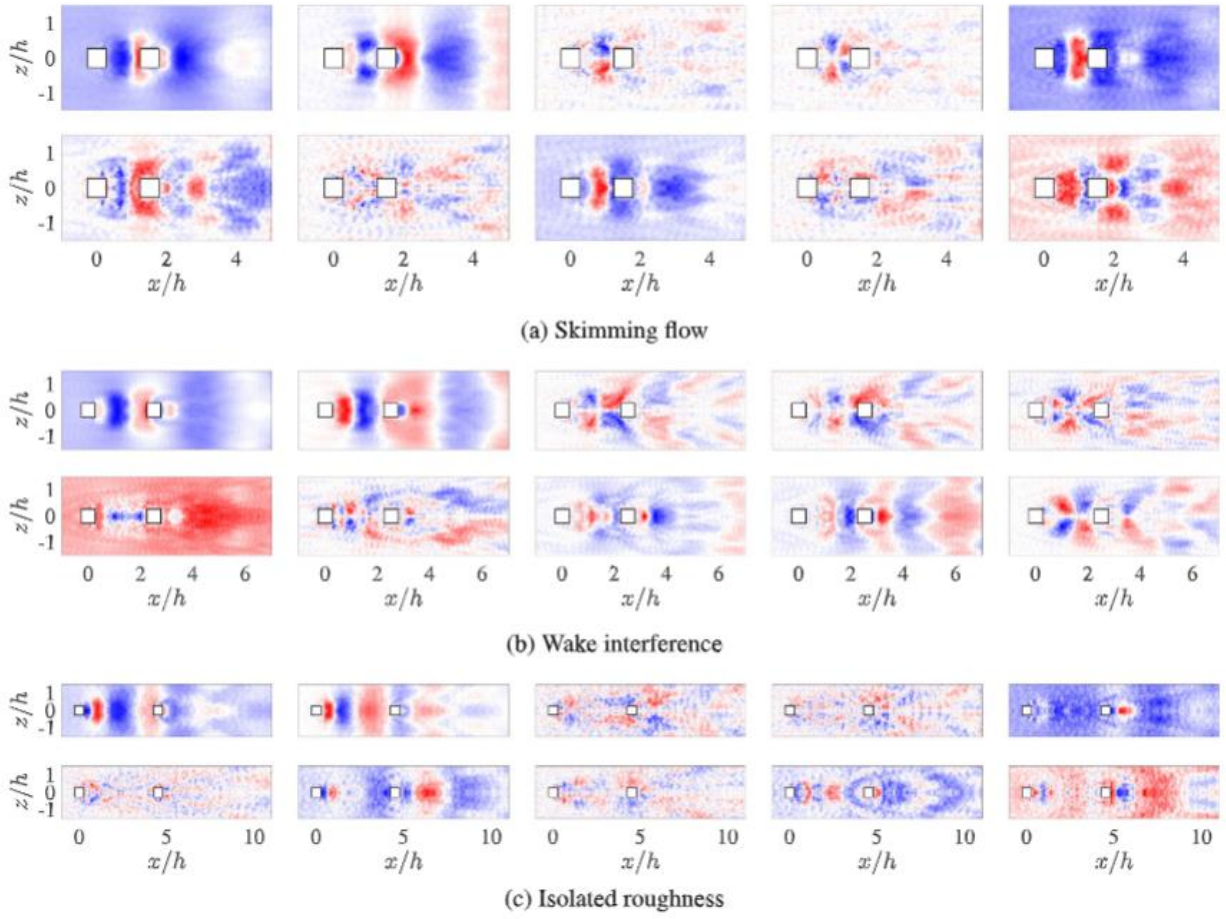
Streamwise velocity patterns.

- 1st 10 most energetic modes.
- 3 different regimes
- Symmetry.
- Vortical structures.

Click here for more information

Results

HOSVD



Spanwise velocity patterns.

- 1st 10 most energetic modes.
- 3 different regimes
- Symmetry.
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Click here for more information


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