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

Superresolution

Deep Learning combined with singular value decomposition to reconstruct databases in fluid dynamics

P. Díaz[1], A. Corrochano[1],
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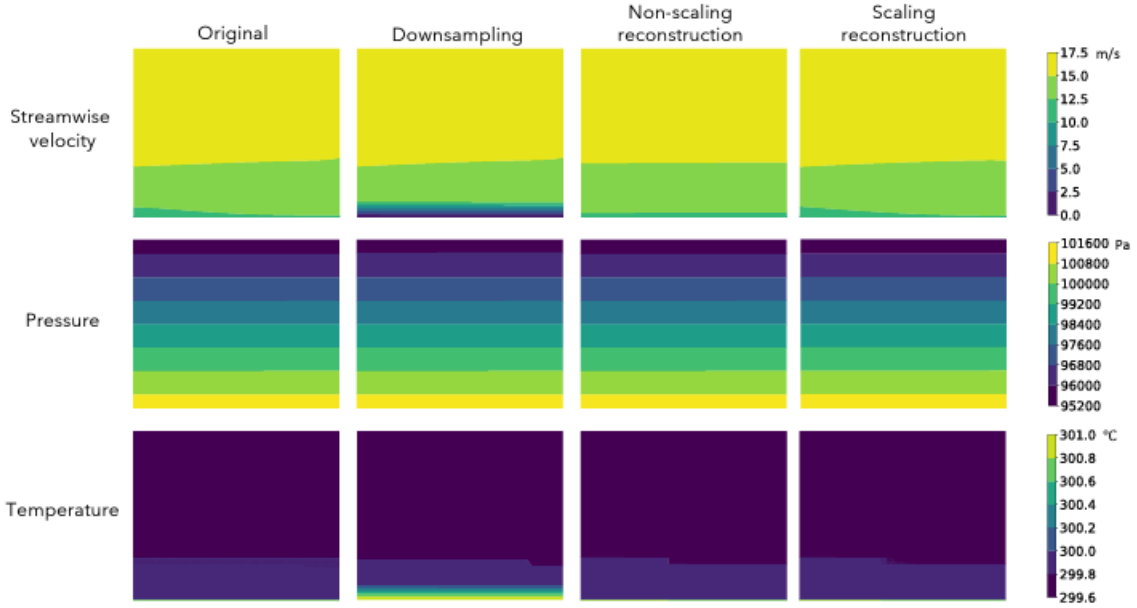
https://doi.org/10.48550/arXiv.2305.08832



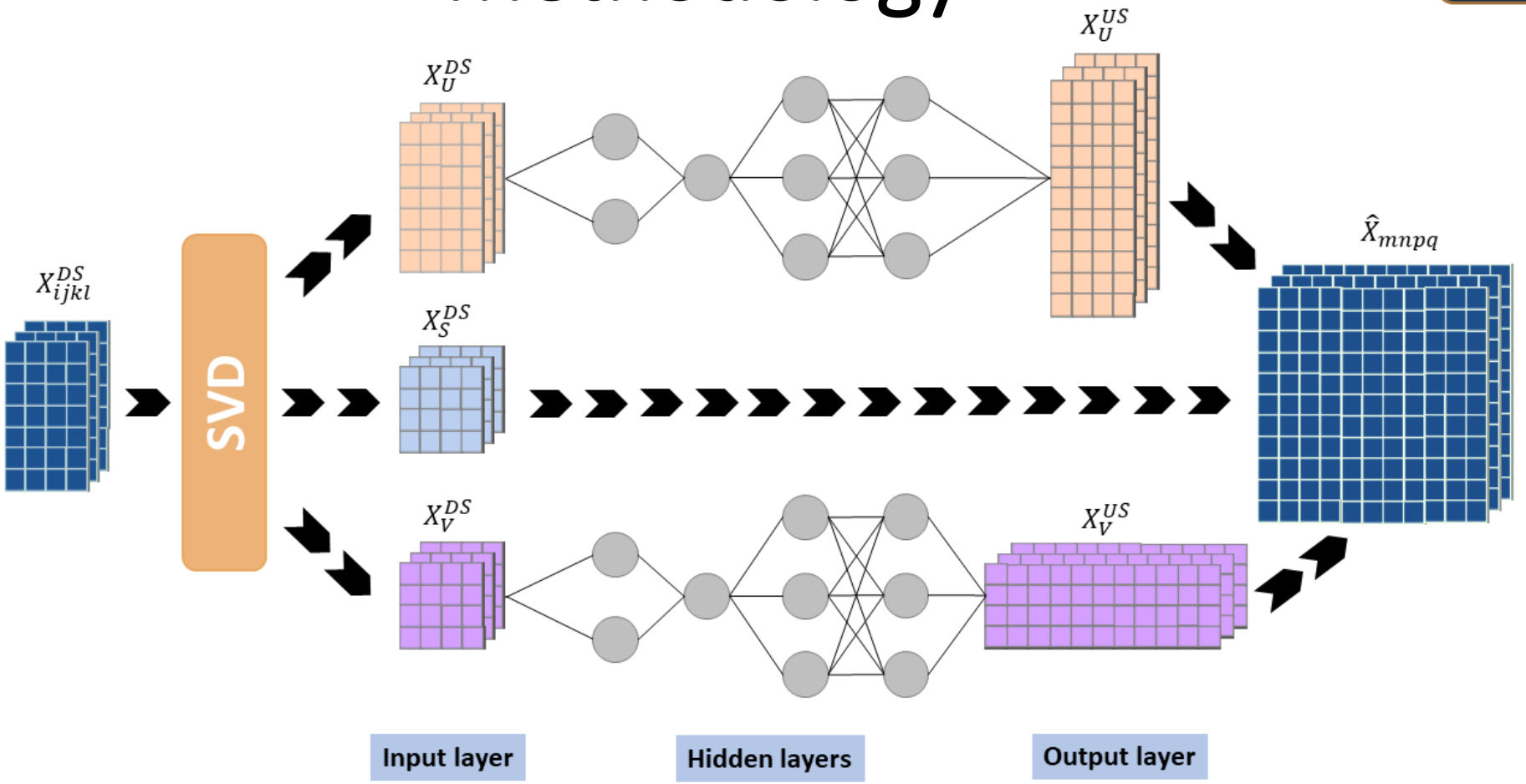
Reconstruction of fluid dynamics databases from few points.

For example, an Atmospheric Boundary Layer (ABL) database.

ModelFLOWs

Methodology

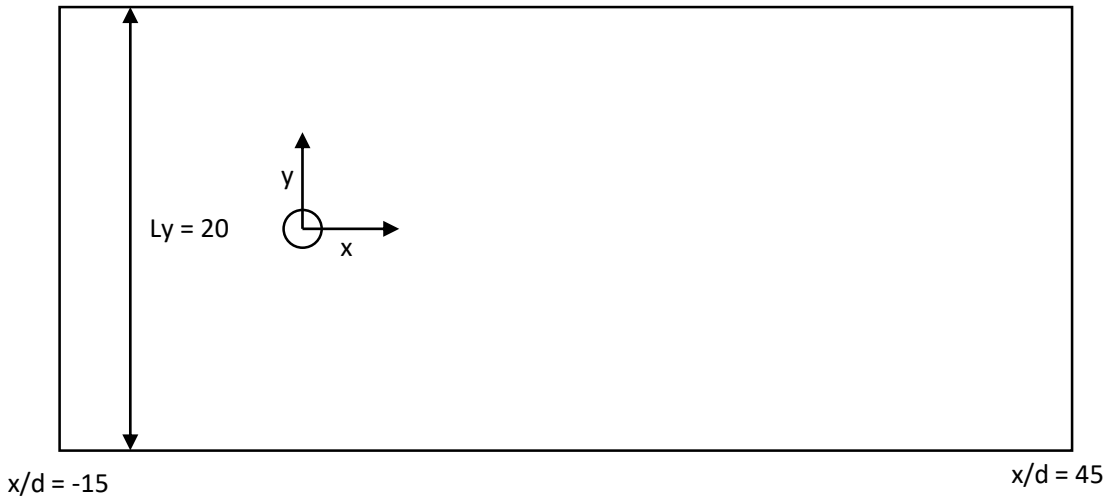
Superresolution



Database & Data preparation

Superresolution

2D Flow past a cylinder at Re = 100



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

Spatial dimensions

Variables

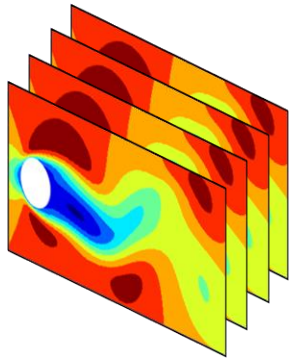
Temporal dimensions

Database & Data preparation

Superresolution

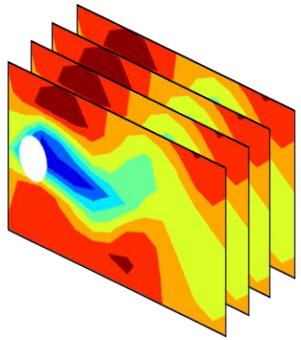
Snapshots Tensor = $\{N_v, N_x, N_y, N_t\}$

- $N_v = 3$
- $N_x = 449$
- $N_y = 199$
- $N_t = 150$



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

- $N_v = 3$
- $N'_x = 15$
- $N'_y = 7$
- $N_t = 150$



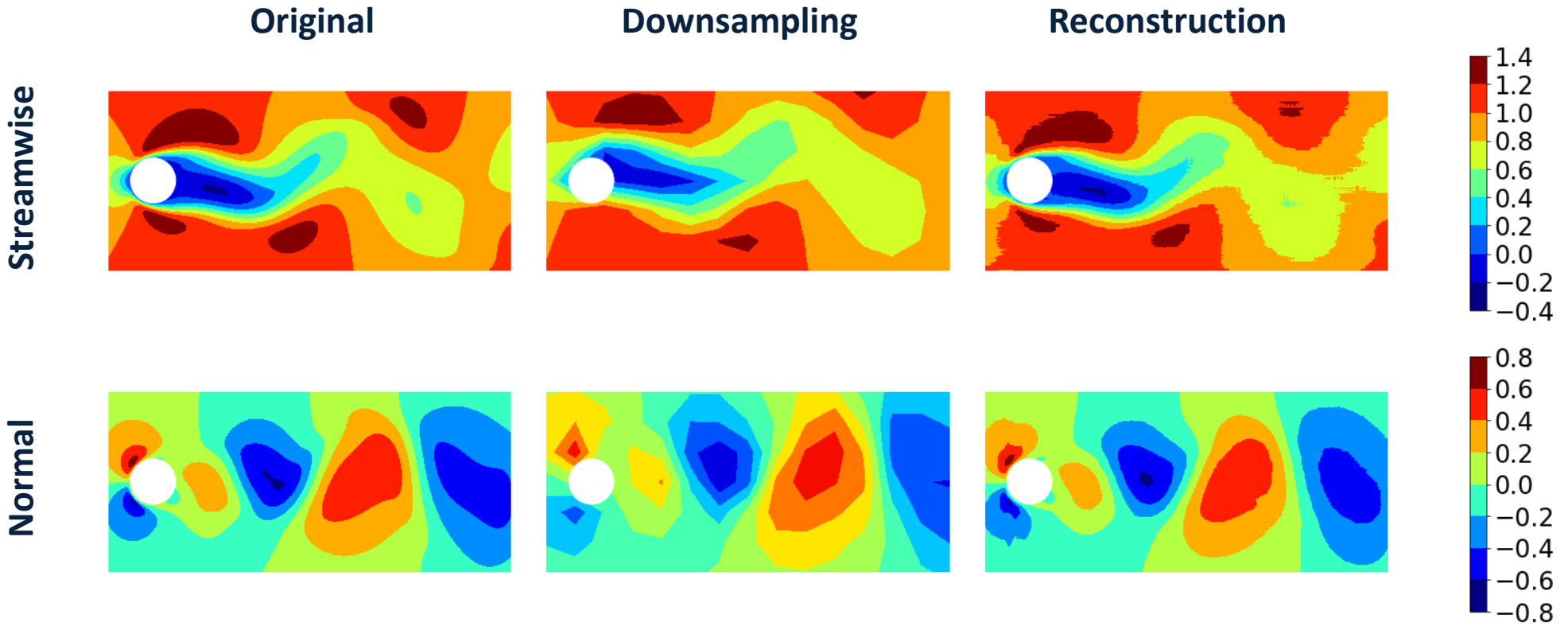
Calibration

Superresolution

Hyperparameters		Value	Typical values
Training size	p_{train}	121	$\leq 80\%$
Batch size	N_{batch}	23	$4, 8, 16$
Epochs number	N_{epoch}	500	$100, 200, 500$
Activation function	AF	$relu$	$linear, elu, sigmoid$
Loss function	l_f	MSE	–
Learning rate	l_r	10^{-3}	$10^{-2}, 10^{-3}, 10^{-4}$

Results

Superresolution

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