

IN-VENTO 2026

An Open-Source Initiative Toward a Unified Framework For Modeling VIV

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LIÈGE université

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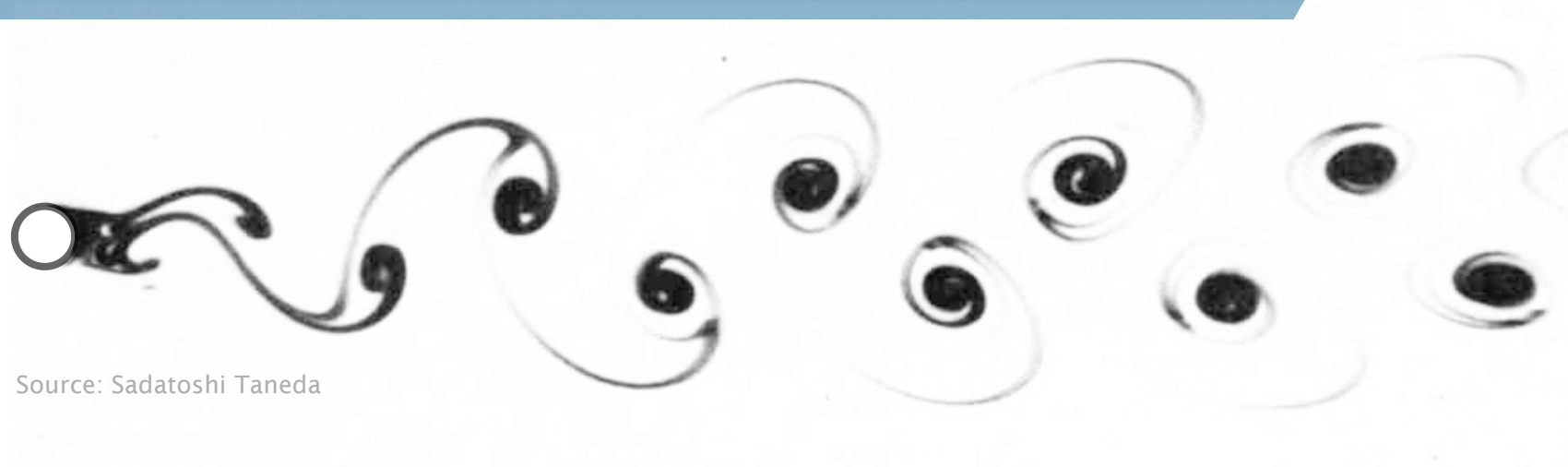
Motivation



Source: Sadatoshi Taneda

EUROCODES

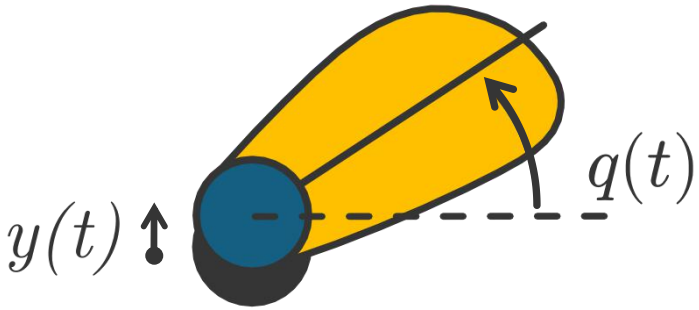
EUROCODES

EN 1991

Actions on structures

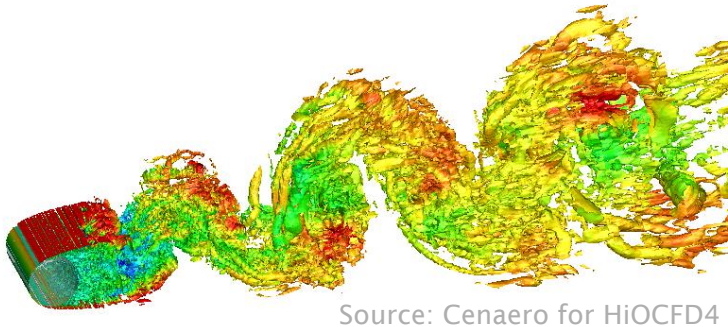
Can be done by hand
Inaccurate in some cases

REDUCED-ORDER MODELS



Takes seconds ~ minutes
BUT ...

CFD



Source: Cenaero for HiOCFD4

Takes weeks
Very precise



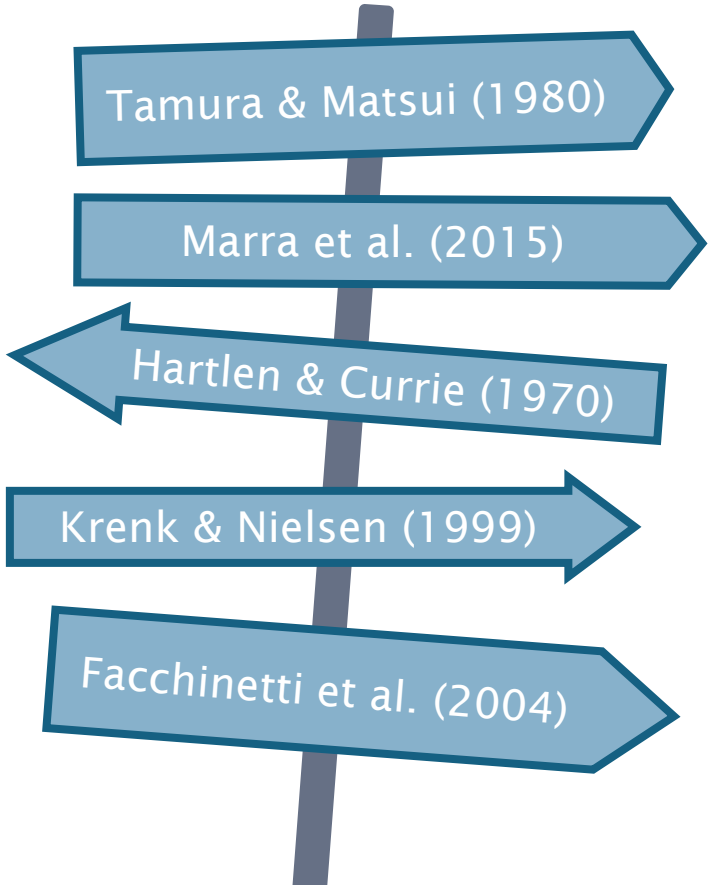
LOW

Precision
Computational load

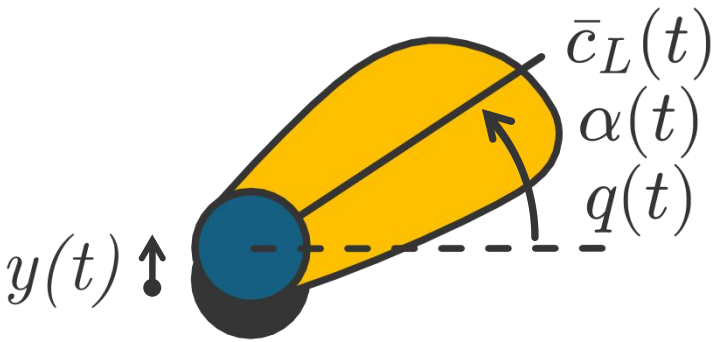
HIGH

Motivation

We need a unified framework to model VIV

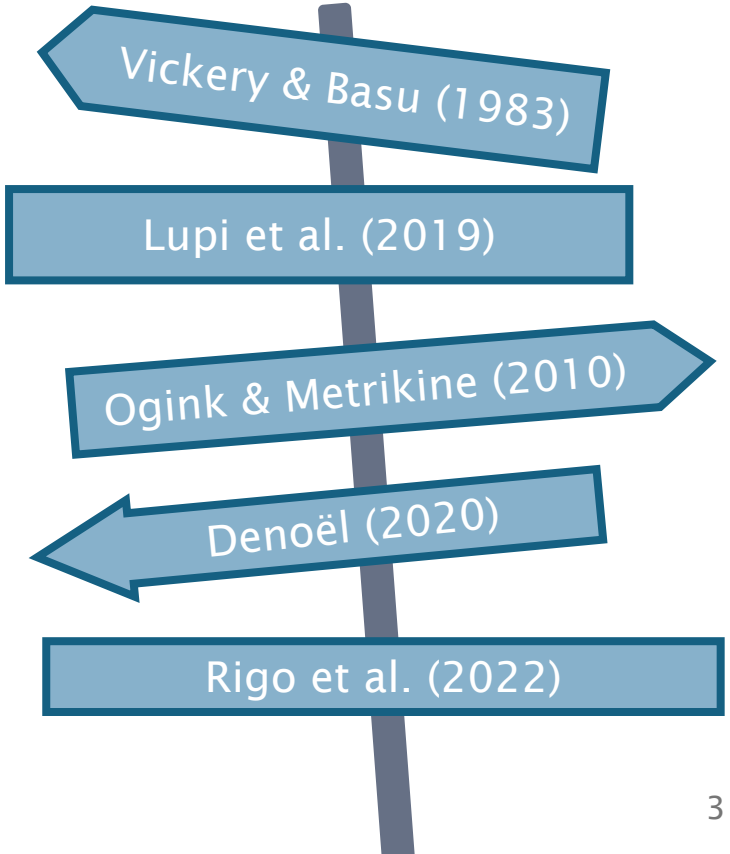


REDUCED-ORDER MODELS



Takes seconds ~ minutes

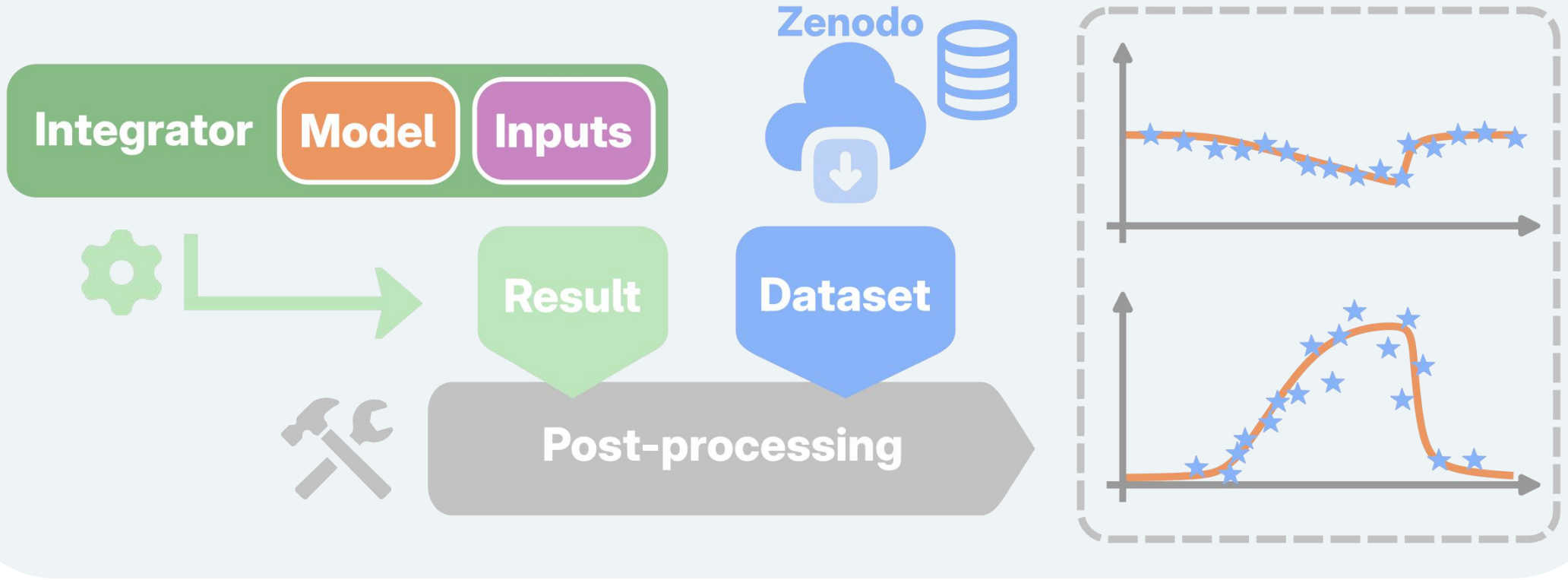
BUT …



Introducing VIVyD

VIVyD

Vortex-Induced Vibration Dynamics



Introducing VIVyD

Inputs

Deterministic
- Arbitrary signal

Stochastic
- Arbitrary PSD
- White noise
- Von Karman
- Generalized VK

Models

Hartlen & Currie
Tamura & Matsui
Facchinetti et al.
Rigo et al.
Generalized

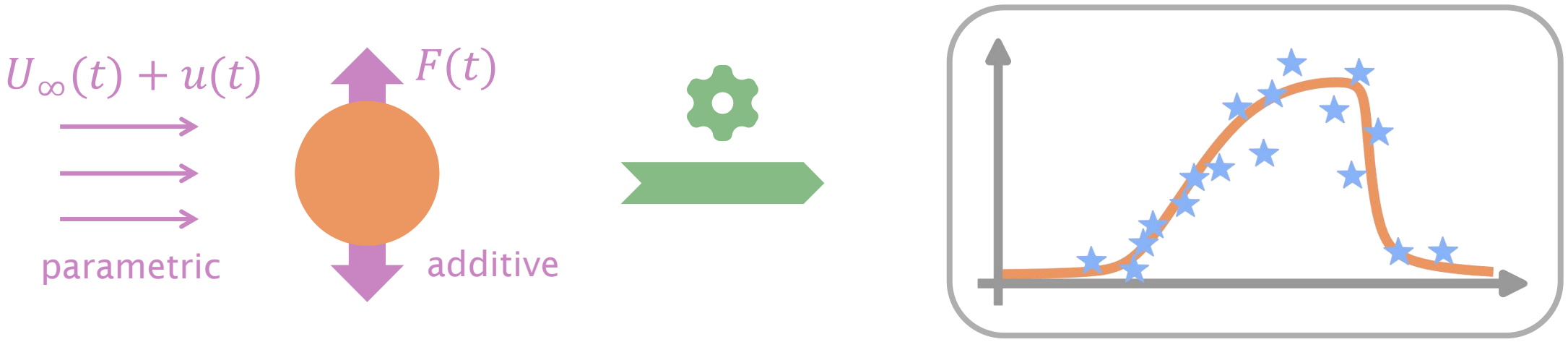
Integrators

Explicit Euler
Midpoint
Runge-Kutta 4 (3/8)
Newmark
Chung Hulbert

Datasets

Zenodo integration

Cunk-compressed file format (.vxp)



Example: Lock-In Curve

Inputs

```
def sweep(t):
    return ANYTHING_YOU_WISH

u_inf = Input(sweep(t_tab), dt)
```

Model

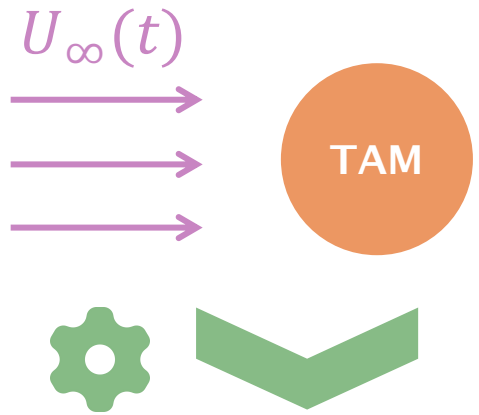
```
model = TamuraModel(
    u_inf, c_m, m_lin, ...
)
```

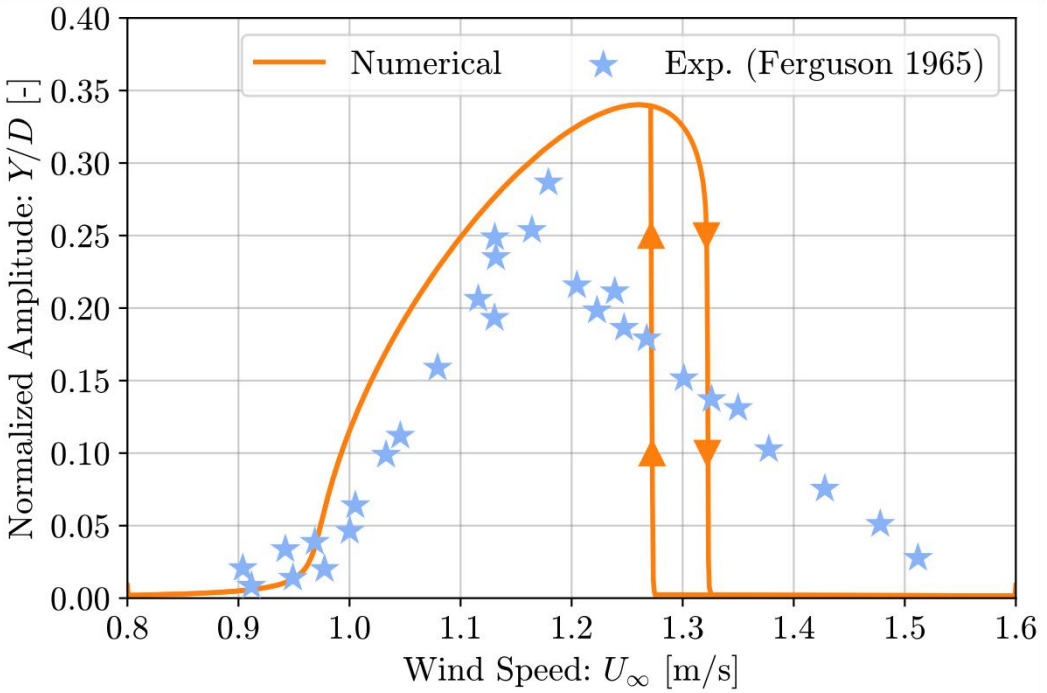
Integrator

```
solver = RK4(verbose=True)
res    = solver.run(model, state0, t_tab)
```

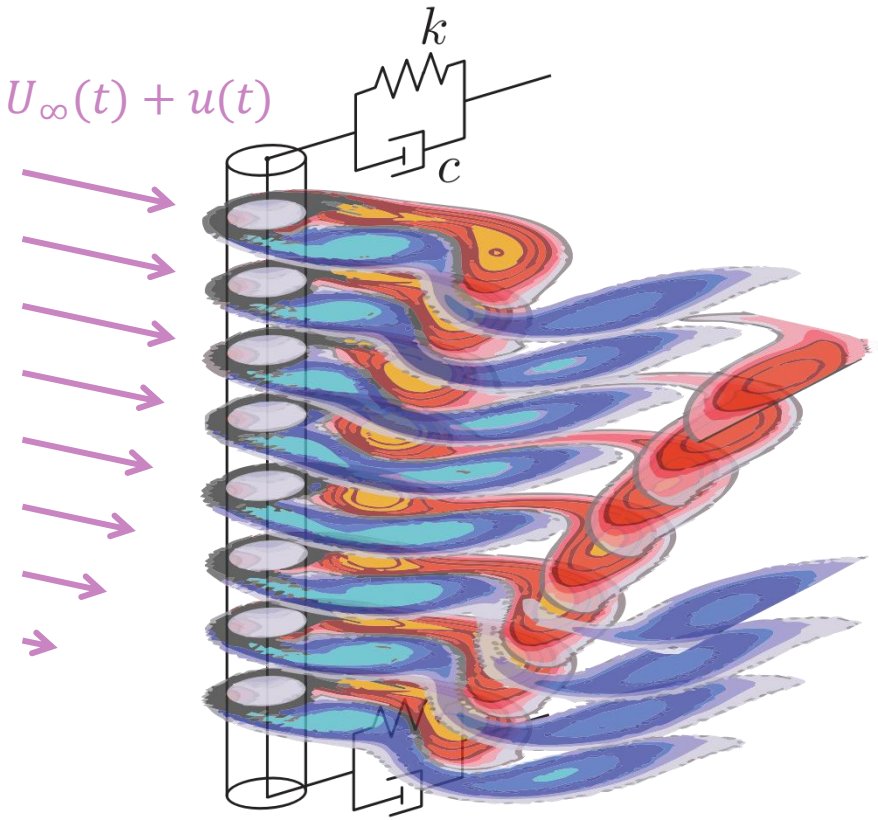
Dataset

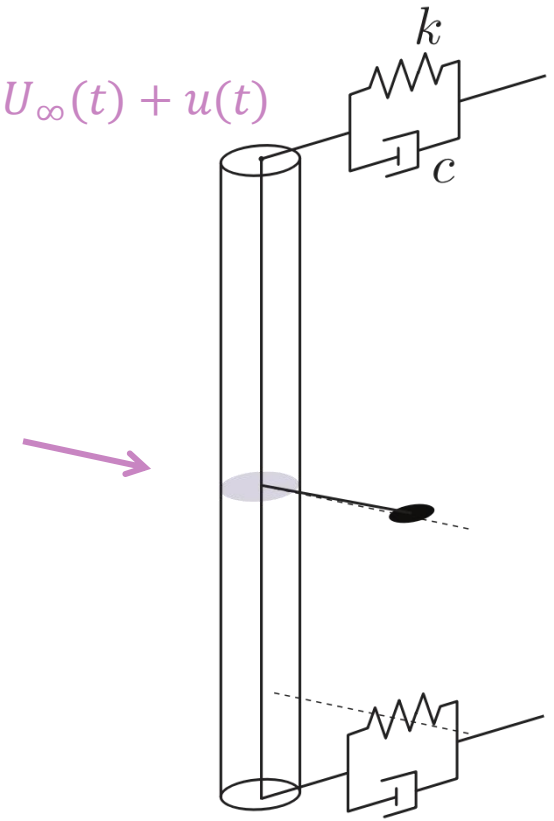
```
DataSet.download_from_zenodo(
    record_id=ZENODO_ID,
    output_dir=DATA_PATH,
)
```

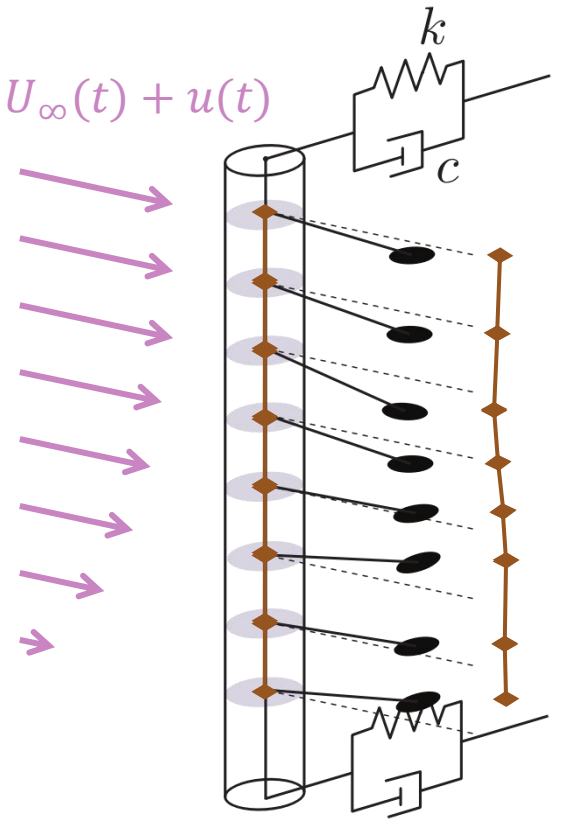




One Step Further: Coupling



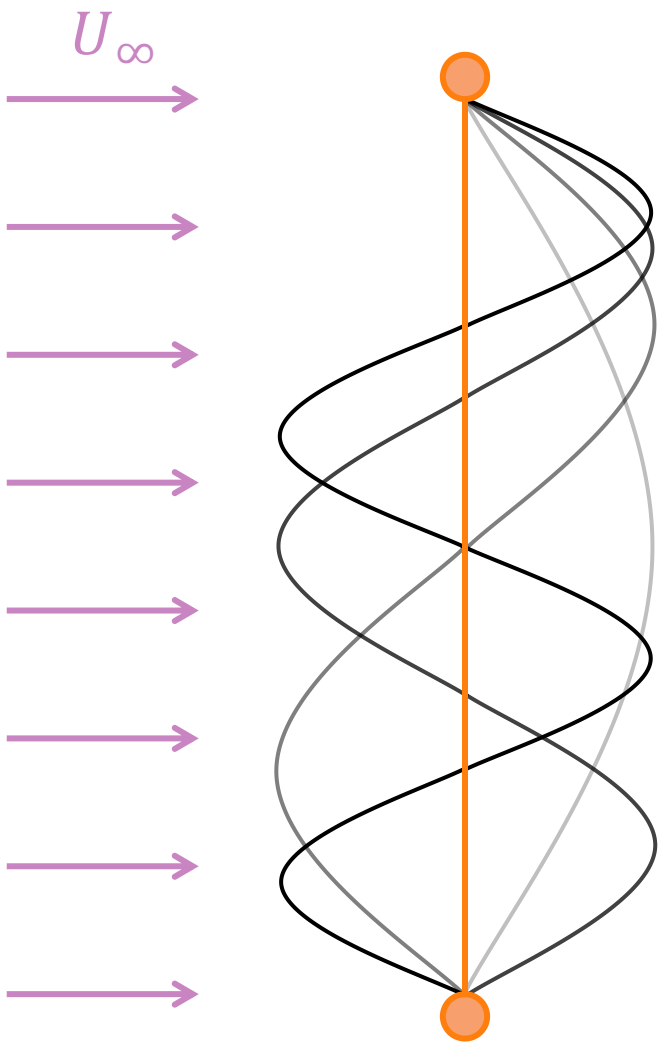


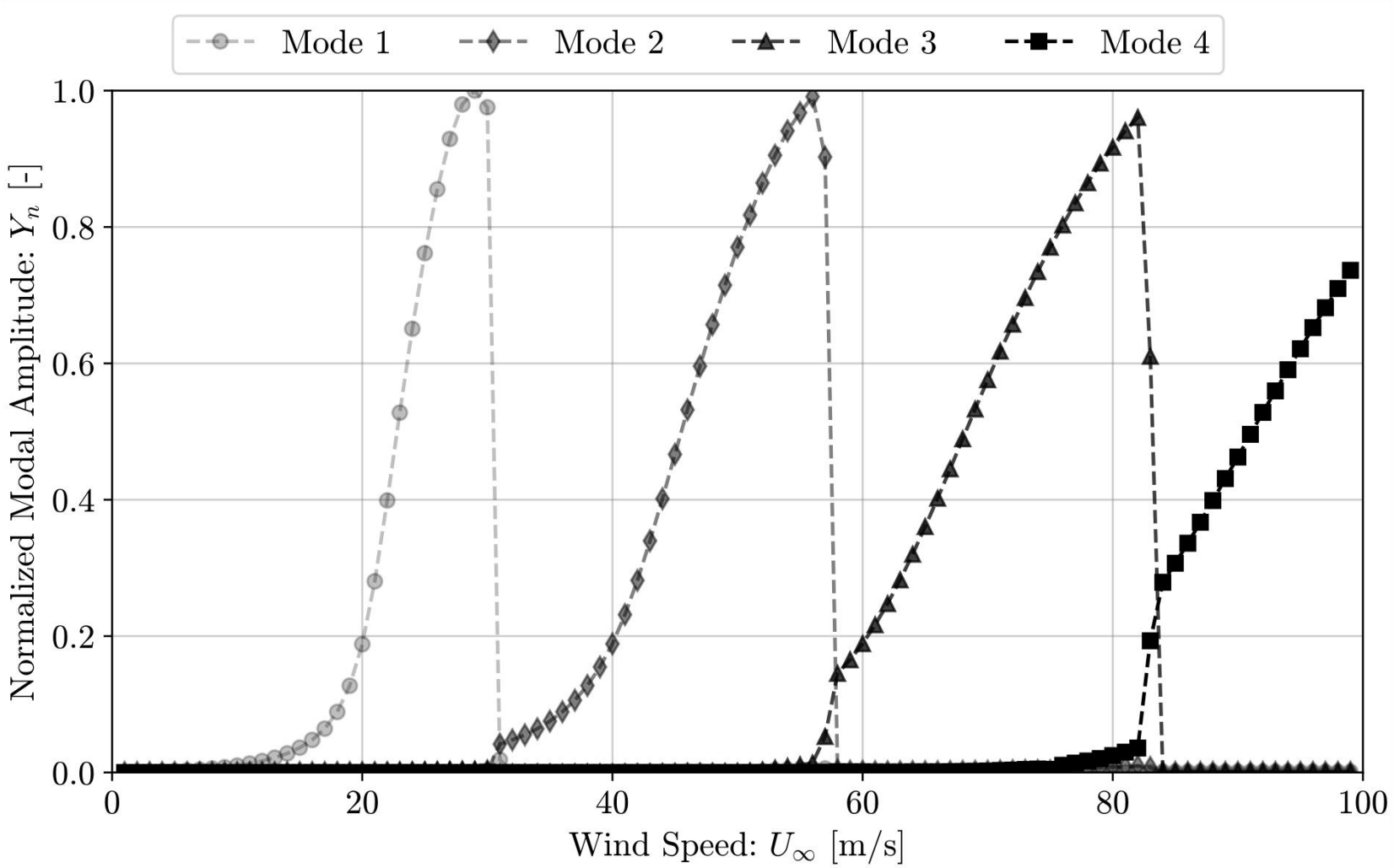


VIVyD

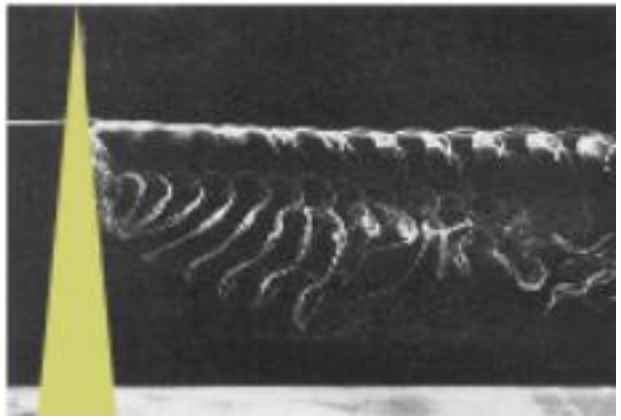
CHAyNS

Example: Structural Coupling

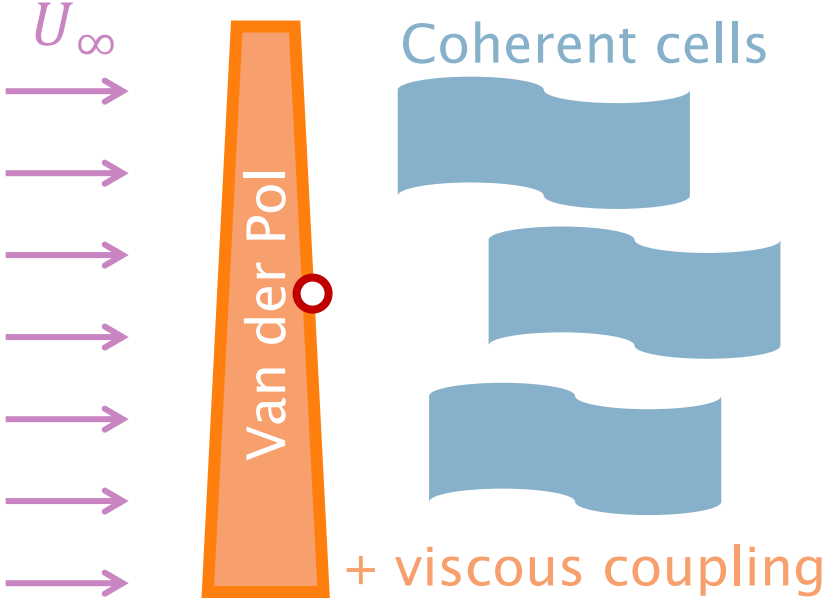




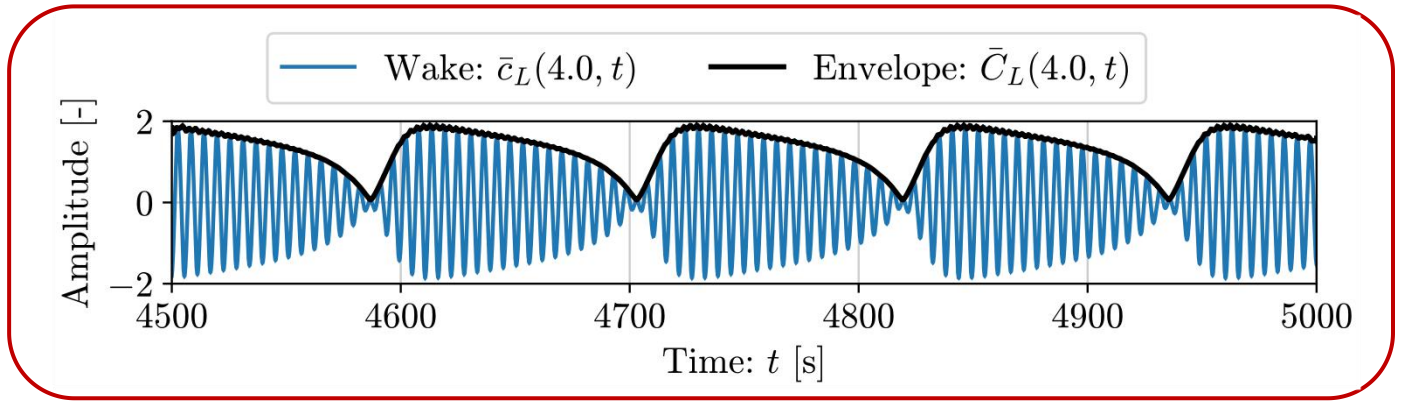
Example: Wake Coupling

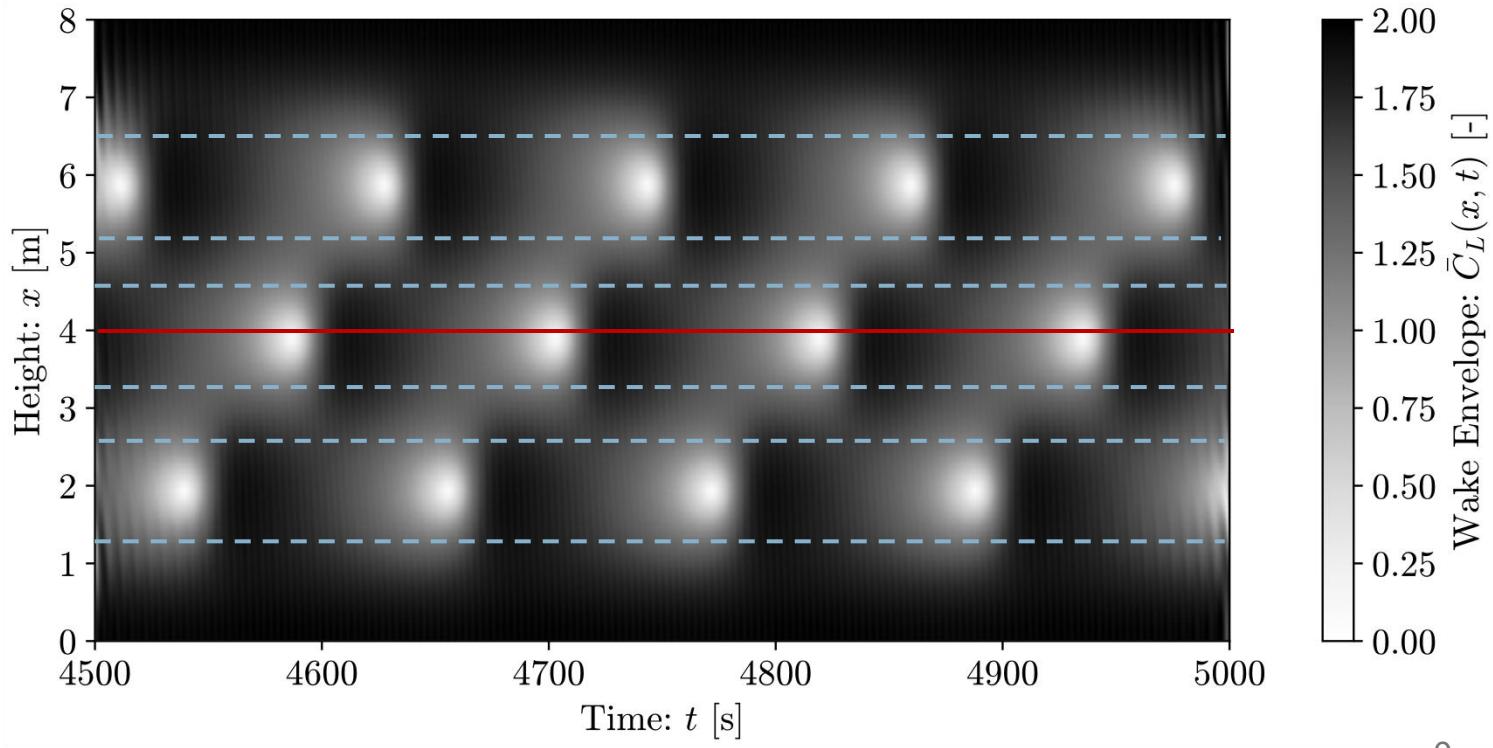


Gaster, 1969



Facchinetti et al., 2002

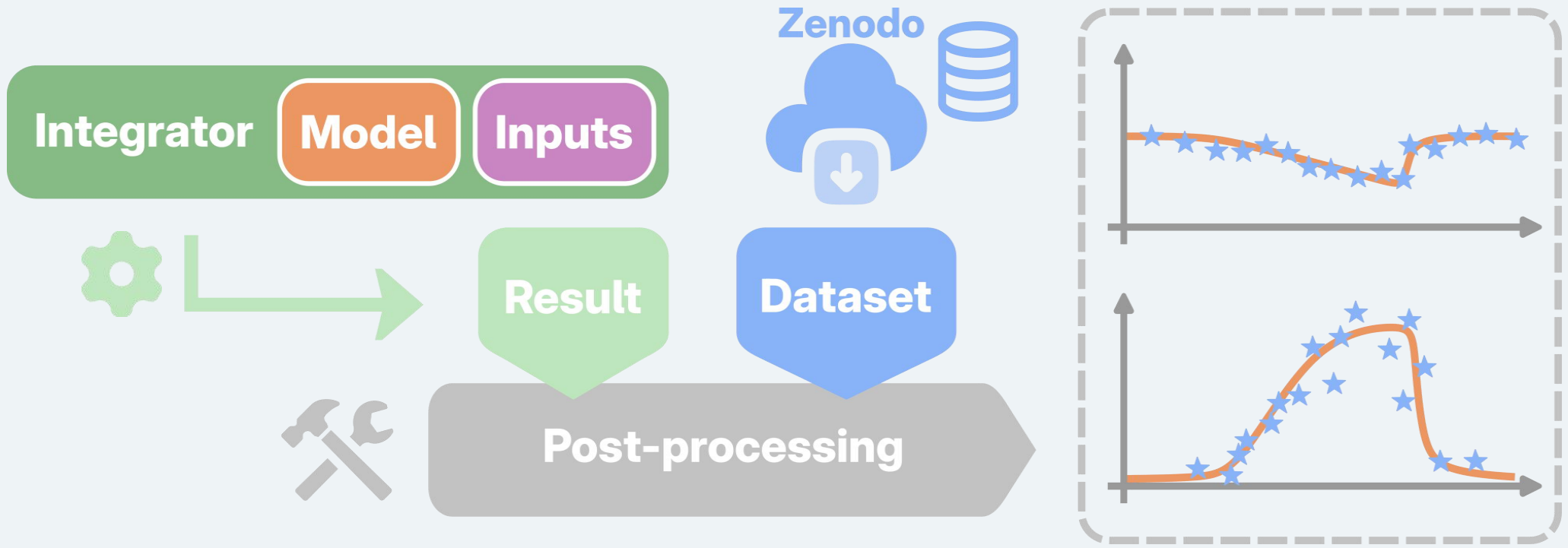




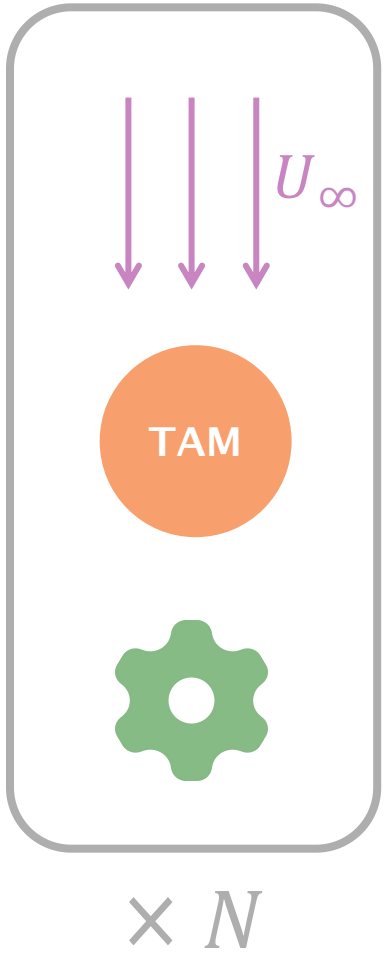
Performance

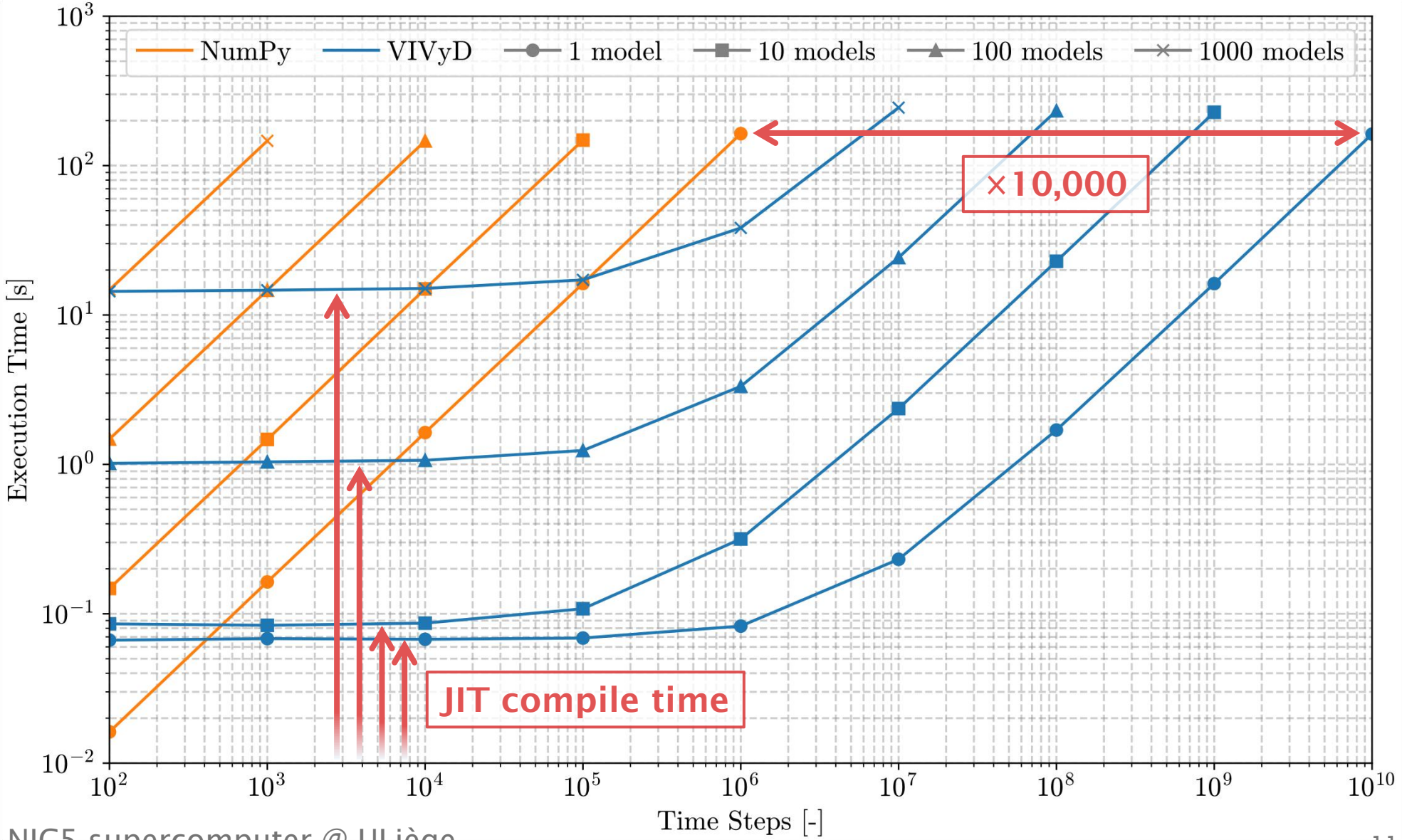
VIVyD

High performance



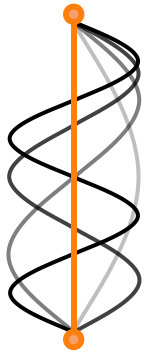
Performance

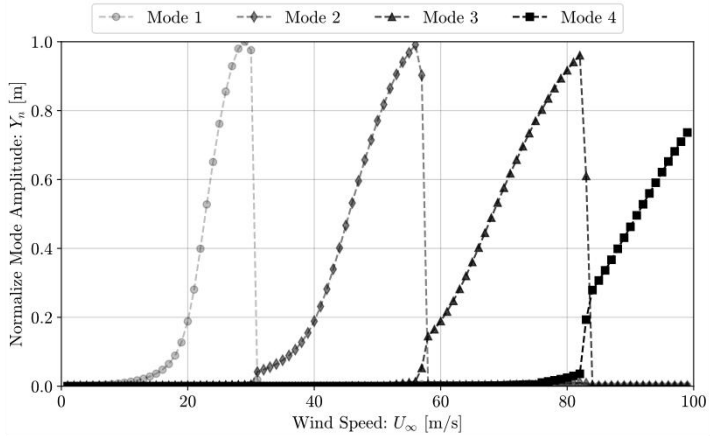




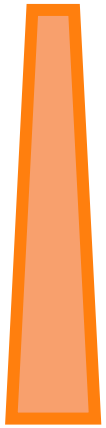
Tests performed on the NIC5 supercomputer @ ULiège

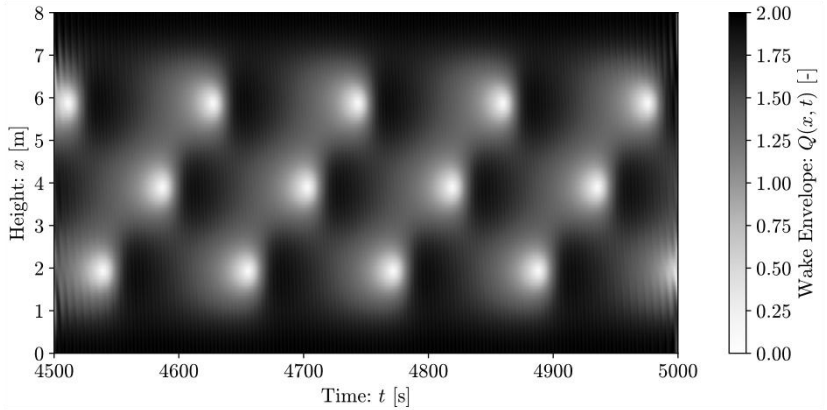
Performance



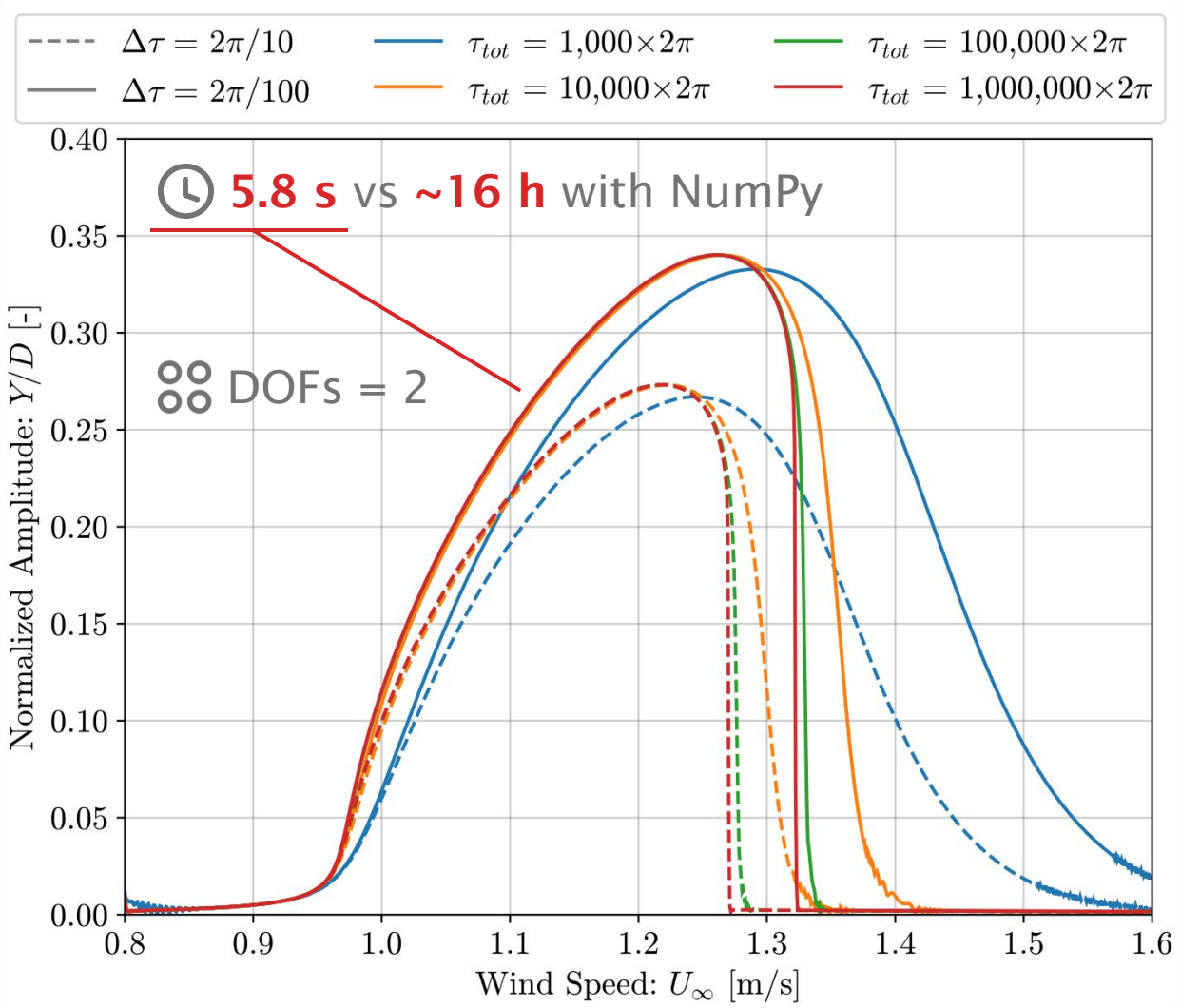


5.6 s each 10^4 DOFs = 400





3.3 s 10^6 DOFs = 200



cf. Tamura & Amano, 1983

Community-Oriented

VIVyD

High performance

Collaborative

Documented

Reliable

Integrator

Model

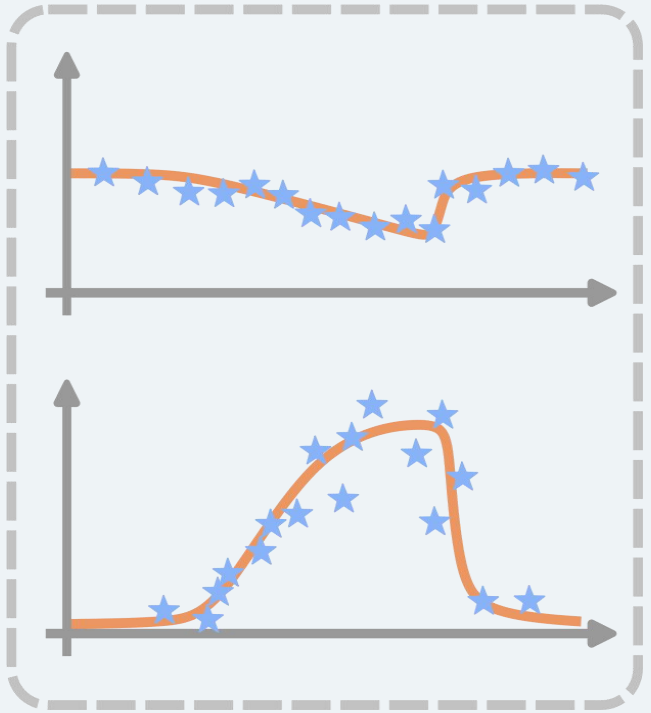
Inputs

Zenodo

Result

Dataset

Post-processing



Community-Oriented

VIVyD: Vortex-Induced Vibration Dynamics

PYPI V0.1.12 | PYTHON 3.12 | 3.13 | 3.14 | MORE FROM US

VIVyD is a Python package for simulating vortex-induced vibrations (VIV). It implements several models for the fluid-structure interaction. The package is designed to be flexible and extensible, allowing users to easily add new models and features.

Documentation

A complete documentation is available online, including installation instructions, usage examples, and API reference. You can access it by clicking the button below.

DOCUMENTATION READTHEDOCS

Support

The best way to get help is to open an issue in the issue tracker of this repository.

ASK FOR HELP OPEN AN ISSUE

Contributing

This project is open to contributions. If you would like to contribute, please fork the repository and create a pull request with your changes. Make sure to follow the coding style and include unitary tests for any new features or bug fixes.

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python™ Package Index

```
❯ pip install vivyd
```

VIVyD documentation — Quickstart | API reference | References — Search Ctrl + K

Collapse Sidebar

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  - vivyd.data.Site
  - vivyd.data.Study
  - vivyd.data.Experiment

API reference > Models > vivyd.models.TamuraModel

vivyd.models.TamuraModel

```
class TamuraModel(*, diam=0.18, St=0.18, c_m=0.05, k_m=39.47841760435743,
m_lin=25.0, rho=1.25, u_inf=1.0, fm=1.16, Cd=1.2, zeta=0.038, Cl0=0.4,
l_star=1.1)
```

[source]

Bases: VIVModel

Tamura & Matsui (1980) wake-oscillator model for vortex-induced vibrations on circular cylinders [TM80]. By identifying the lift and transverse drag forces, the mechanical equation of motion of the cylinder is written as

$$\ddot{y} + \frac{c}{m}\dot{y} + \frac{k}{m}y = -\frac{\rho U_\infty^2 D}{2m_{\text{lin}}}\left(f_m\left(q + \frac{\dot{y}}{U_\infty}\right) + C_D\frac{\dot{y}}{U_\infty}\right),$$

and the equation of the wake is written as

$$\ddot{q} + 2\zeta\omega_s\left(4\frac{f_m^2}{C_{L0}^2}q^2 - 1\right)\dot{q} + \omega_s^2\left(q + \frac{\dot{y}}{U_\infty}\right) = -\frac{\ddot{y}}{D\left(\frac{1}{2} + l^*\right)},$$

with

$$\omega_s = 2\pi \mathrm{St}\frac{U_\infty}{D}.$$

Parameters:

- **diam** (*float, optional*) – Diameter of the cylinder, D. Default is 0.18 m.
- **St** (*float, optional*) – Strouhal number, St. Default is 0.18.
- **c_m** (*float, optional*) – Specific mechanical damping, c/m. Default is 0.05.
- **k_m** (*float, optional*) – Specific mechanical stiffness, k/m. Default is $4\pi^2$.
- **m_lin** (*float, optional*) – Mass per unit length of the cylinder, m_{lin}. Default is 25.0 kg/m.



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VIVyD

Thank you for your attention!

```
❯ pip install vivyd
```

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