

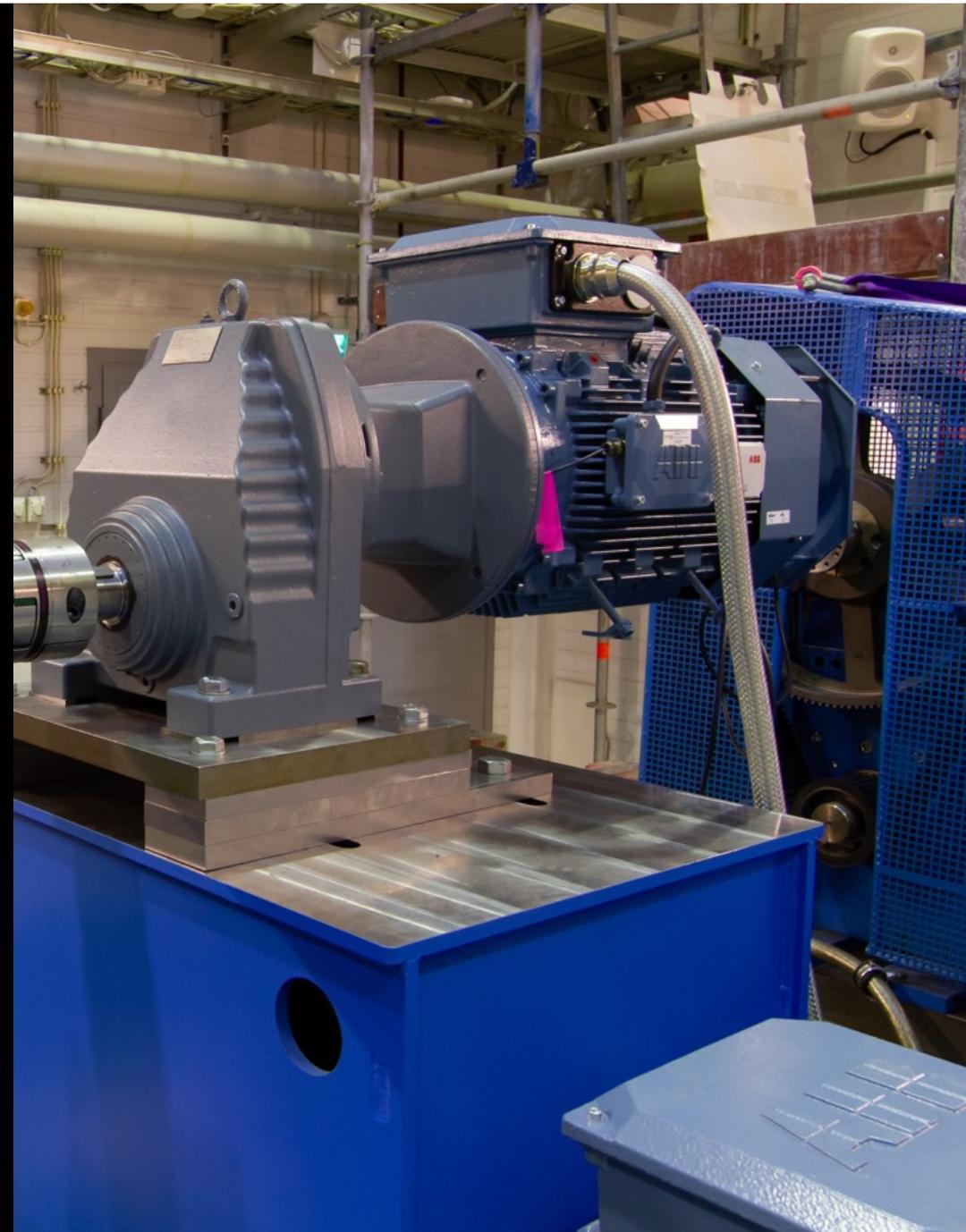
Straightforward modelling of electric powertrains in openTorsion platform

—

Sampo Laine, Urho Hakonen, Risto Viitala
Mechatronic Circus 8.4.2020



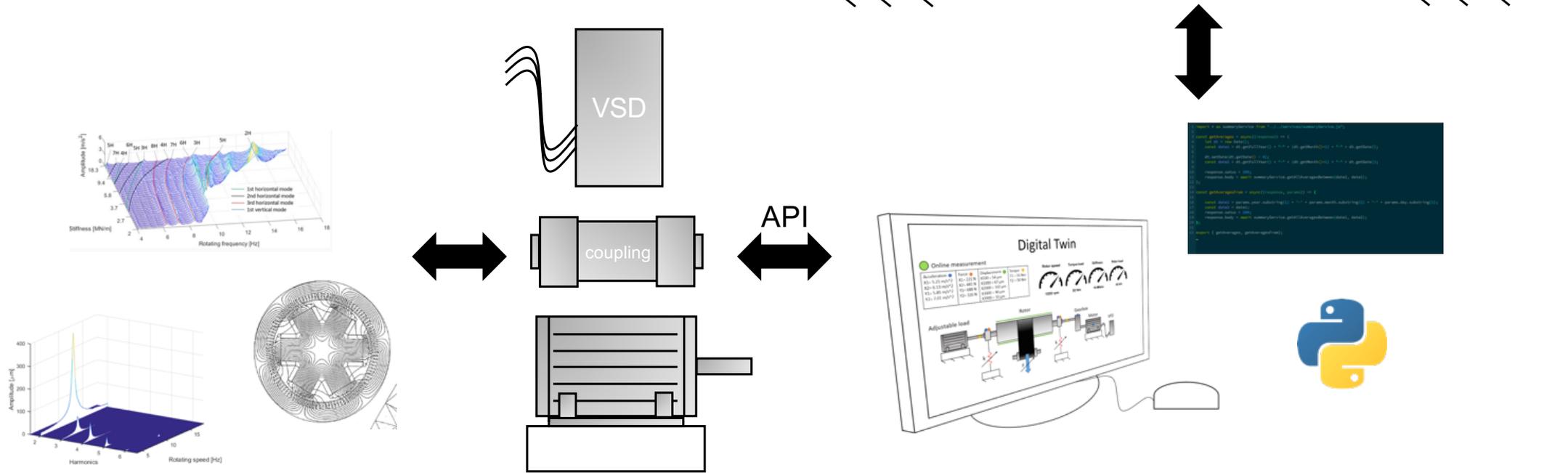
Aalto-yliopisto
Aalto-universitetet
Aalto University



Motivation

- **The use of electrical drives is drastically increasing in the sustainable future**
- **Torsional analysis typically required in the design of VSD applications to**
 - Ensure functionality and operability
 - Prevent delays, brand damages and early service
- **Model of the entire powertrain is required**
- **New highly portable modelling methods enable effective modelling of electric machines**

“Ecosystem of digital twins”



Automated company protocols

- Parametrized models
- Protected information
- State-of-the-art simulation
- Product test data

Distribution of digital twins

- Abstracted digital representations
- Excellent availability through web-based interfaces

Modelling software

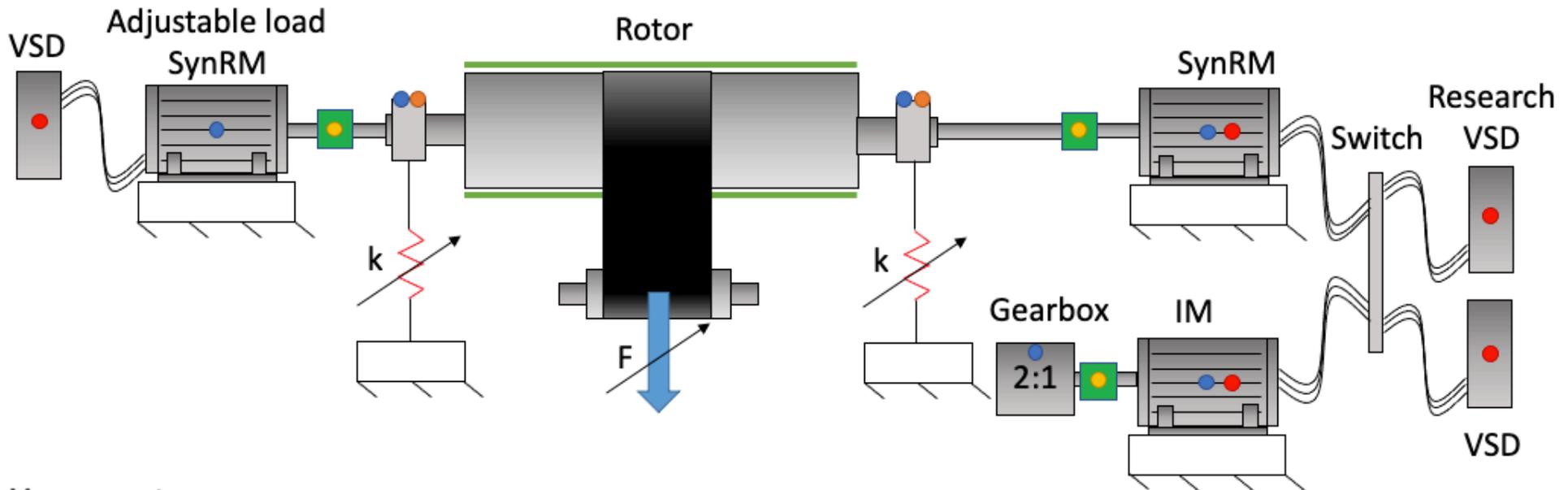
- openTorsion (*published soon*)
- Optimal modelling is possible without compromising company protected data
- Developed as open source software

Full-scale powertrain test setup



- Model verification and validation in different setups
- Highly versatile electric powertrain in laboratory environment to demonstrate different powertrains in varying operating conditions

The unique powertrain measurement capabilities of the AROTOR lab



- Measurements:
- Acceleration
 - Force
 - Displacement
 - Torque
 - Electrical

Torsion demo localhost:5000

AROTOR

Aalto University
Rotor Laboratory

Electric powertrain modelling with openTorsion

Component selection

New component

Induction motor
3GAA 112002-ACD

Coupling
R+W EZ2 800

Roll

Calculate response

Eigenmode Frequency (Hz)

0
1
2

Plot Campbell

Clear all

Electric powertrain modelling with openTorsion

backup

Component selection

New component

Variable-frequency drive



Gear 2



Coupling 2



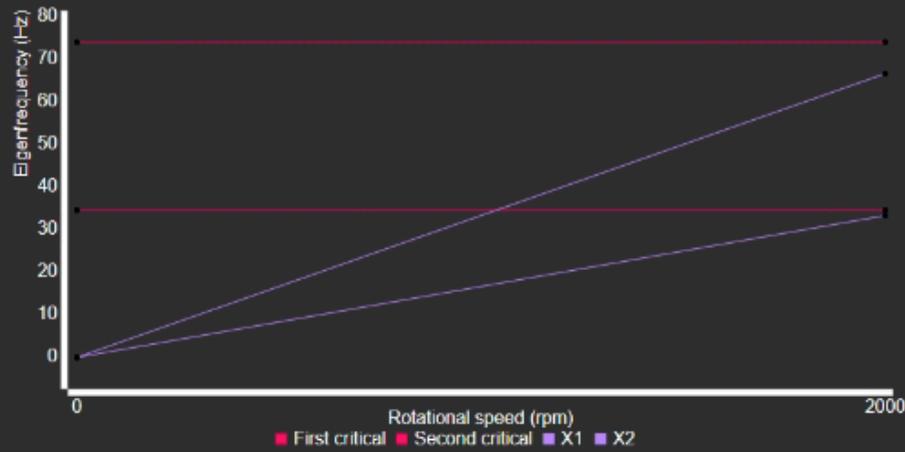
Calculate response

Eigenmode Frequency (Hz)

0	0
1	34.625
2	74.079

Plot Campbell

Clear all



Conclusions

- **OpenTorsion platform enables the simple creation of holistic powertrain models for torsional vibration analysis**
- **Open approach invites collaboration between academia and the industry**

Sampo Laine
Urho Hakonen
Risto Viitala



Aalto-yliopisto
Aalto-universitetet
Aalto University