Hybrid AI
@ SystemX

Visit of the Czech AI Delegation to SystemX

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Credit to IA2 Program

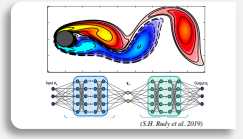
Hybrid AI: The Research Program IA2 @ SystemX

IA² Intelligence artificielle et ingénierie augmentée

- a program with **6 R&D collaborative projects** based on concrete **industrial** use cases
- Area: Hybrid AI

Advance project
Thesis / Postdocs / Shared work

HSA: Simulation/machine learning hybrid modeling
How industrials solvers and learned models can enrich each other ?
01



AFS: Agility and fidelity of simulations
How to imporve agility and fidelity of simulation in complex systems design?
02

S2I: Industrial infrastructure supervision
How to improve decision-making on distubuted industrial systems via machine learning technices ?
03

SAA: Augmented multi-agent simulation
How can multi-agent models benefit from real data and bring out atypical situations?
04

SMD: Business Semantics for Multi-source Data Mining
How to link heterogeneous data with established practical knowledge?
05

CAB: Cockpit and Bidirectional Assistant
How to develop a virtual assistant that learns from expert and learns the expert
06

HSA Project : Simulation/machine learning hybrid modeling

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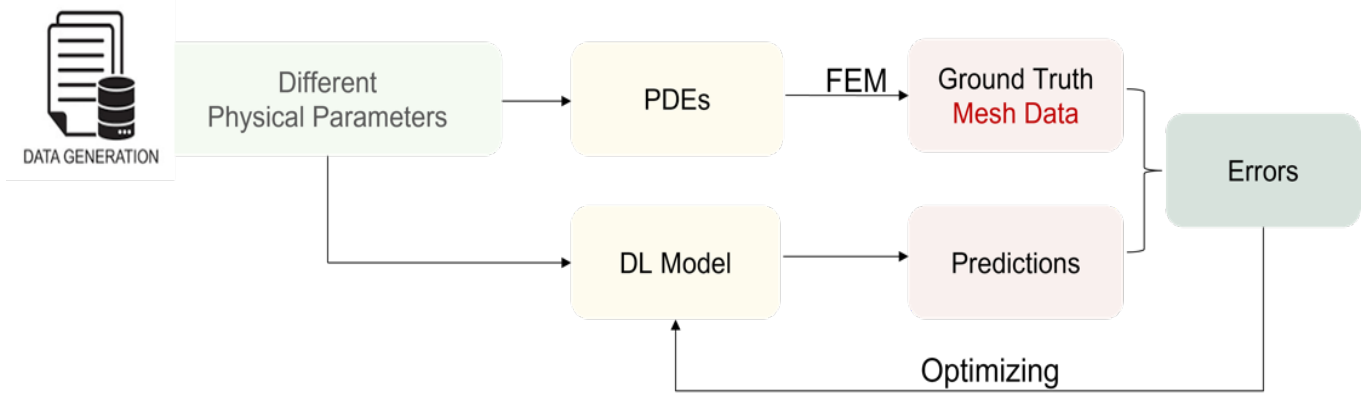
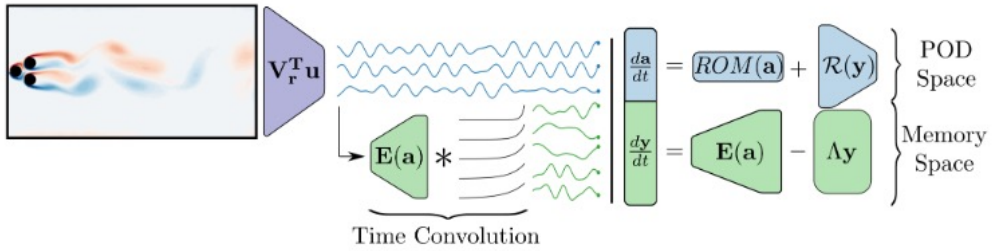
https://www.irt-systemx.fr/projets/HSA/

Challenges

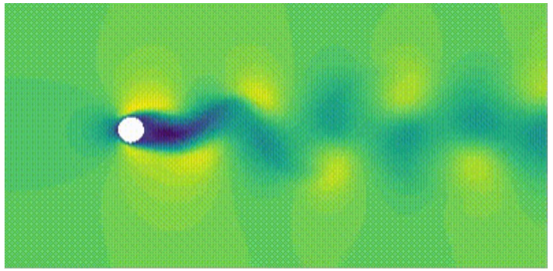
- Augementing/Replacing physical solvers with data-driven models that integrate physical constraints
- Physics-Informed Machine Leaeninrg as surrogate models for physical simulation



Deep Graph Neural Networks for Numerical Simulation of PDEs
PhD thesis de W. Liu. 2023 (LISN, Inria/SystemX)



High-Dimensional non-linear Physical Equations



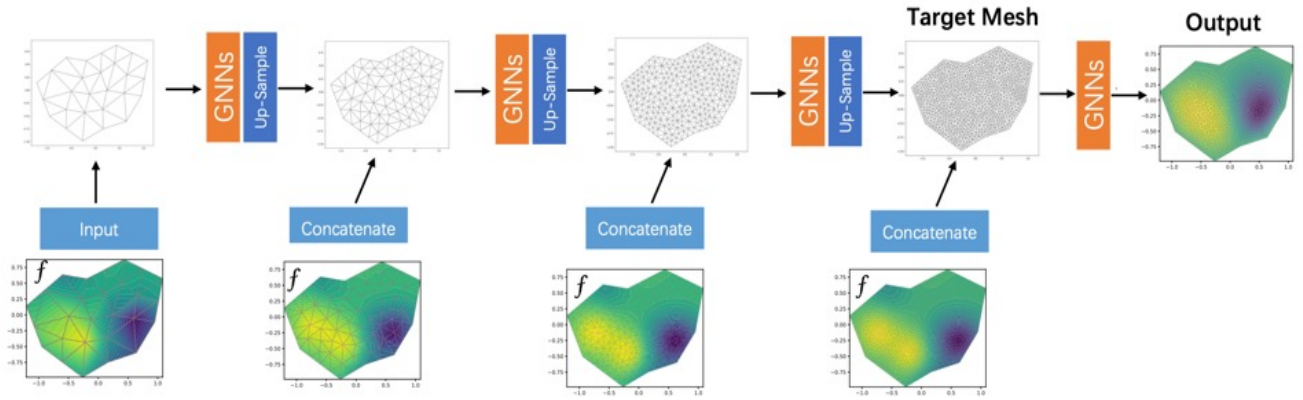
Reduced models and deep learning for PDEs
PhD Thesis of E. Menier (en cours) (LISN, Inria/SystemX)

SystemX Air Liquide MICHELIN AIRBUS Rte SNCF EDF Inria

Projet HSA : simulation and deep learning of graphs

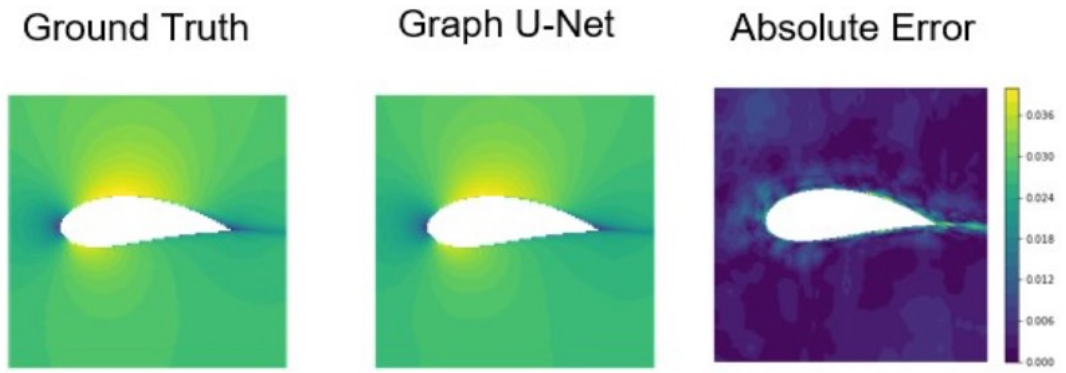
Intelligence artificielle et ingénierie augmentée

Graph Neural Nets for 3D meshes
More suitable, as they operate by construction on graphs



Prediction of the airflow profile around an aircraft wing (Air Foil)

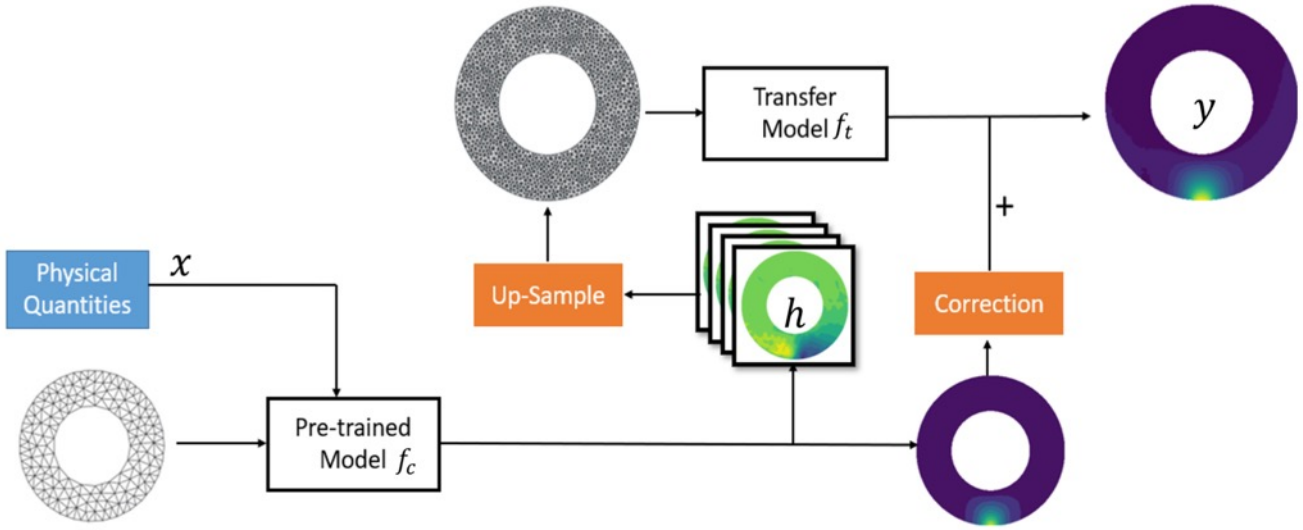
Physics: Navier-Stokes equations



PhD theis of W. Liu, 2023 (LISN, Inria/SystemX)

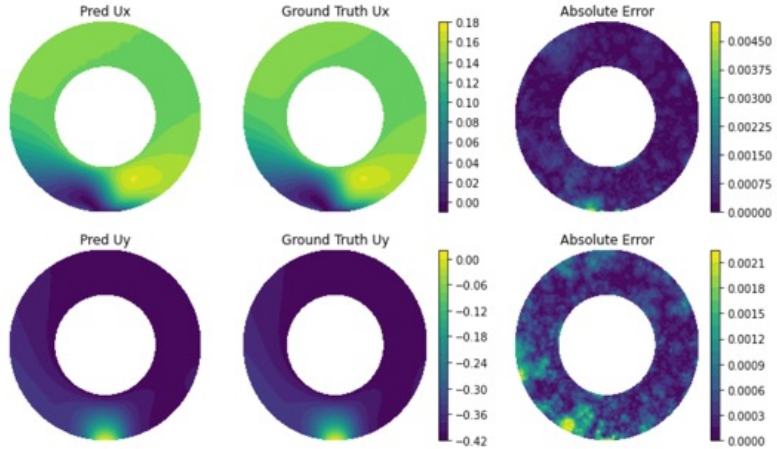
Hybridization and transfer learning

- Generic nature of the learned models
- Transfer learning for improved results
- Prediction can be improved via transfer learning: from low fidelity (coarse mesh) to high fidelity (finer mesh) models



Wheel contact profile

Physics: contact equations



PhD Thesis of W. Liu, 2023 (LISN, Inria/SystemX)

Thank you for your attention!