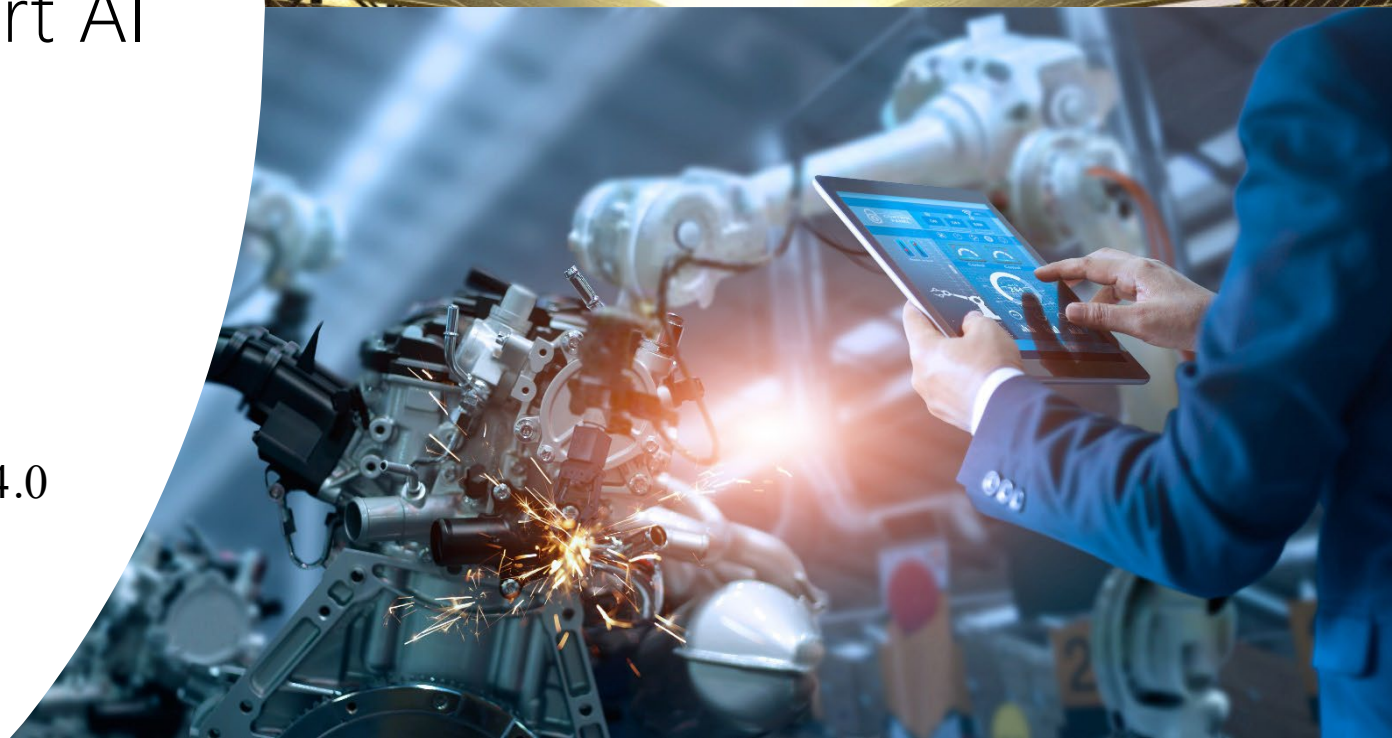
School of Engineering

Creating maintenance models by combining engineering knowledge with state-of-the-art AI

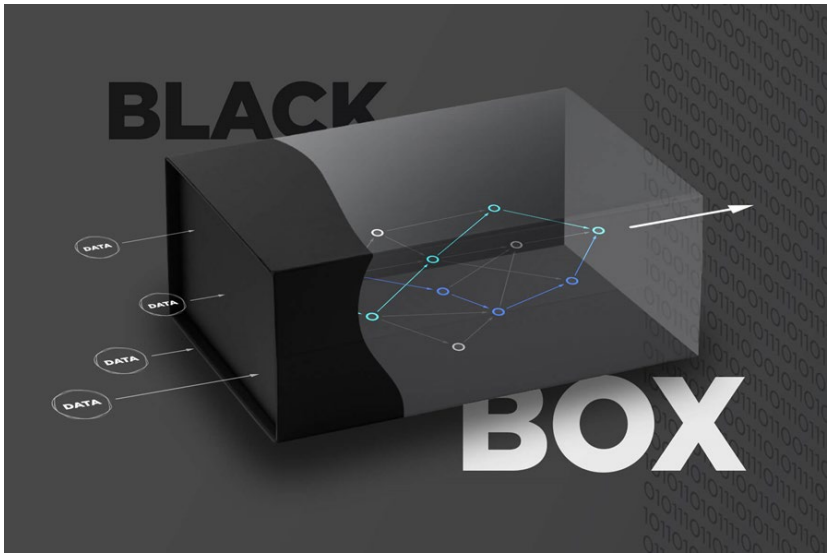


Dr. Manuel Arias Chao
ZHAW School of Engineering

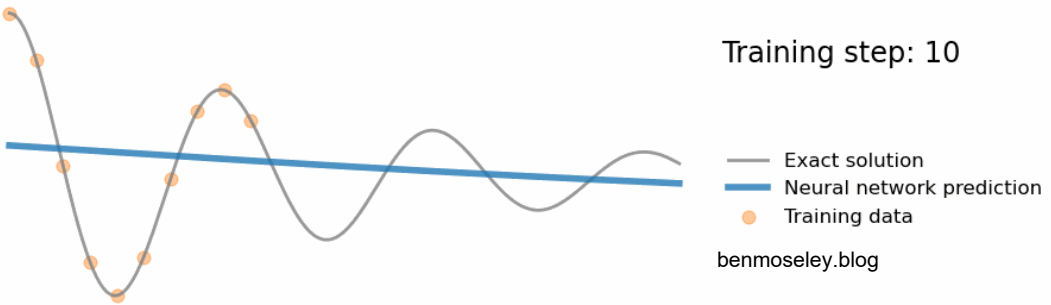
F&E-Konferenz zu Industrie 4.0

Purely data driven solutions are often hindered by their:

black-box nature



low generalizability with **limited data**
&
overly optimistic predictions

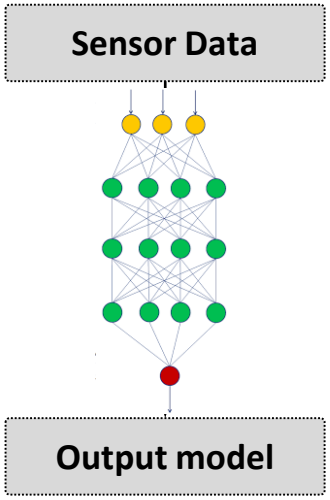


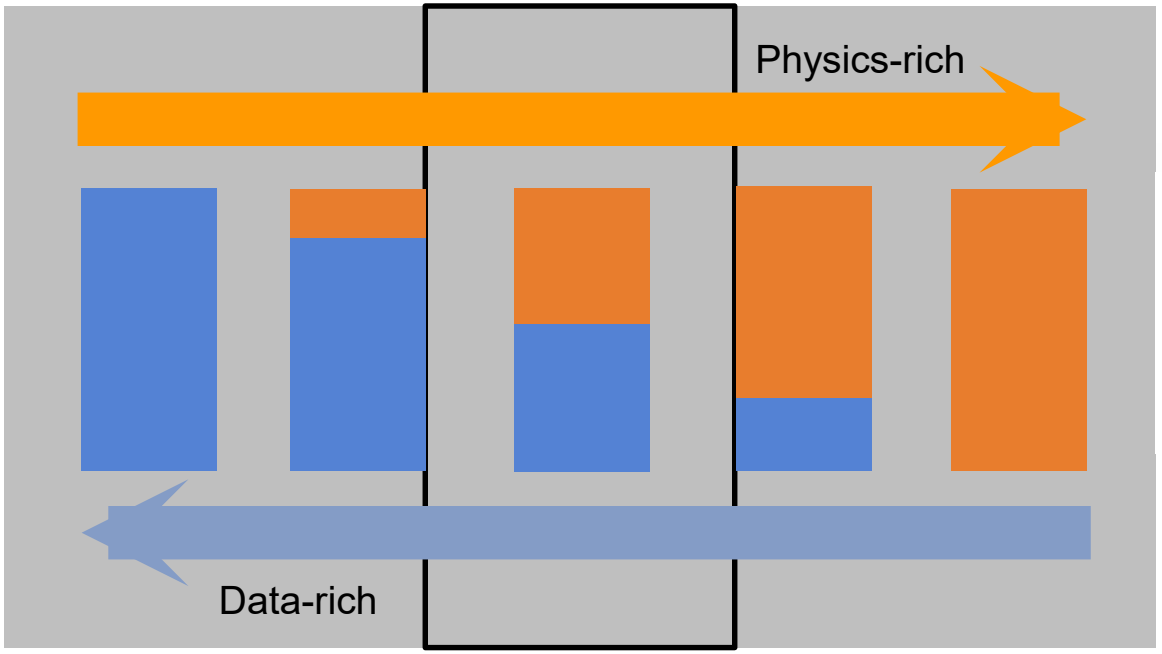
For diagnostics and prognostics of complex systems, transparency and performance are equally important!

Typical Situation for Maintenance

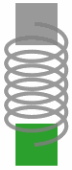
some data + some physics

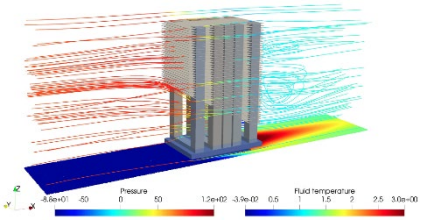
Deep Learning





Physics-based Modeling

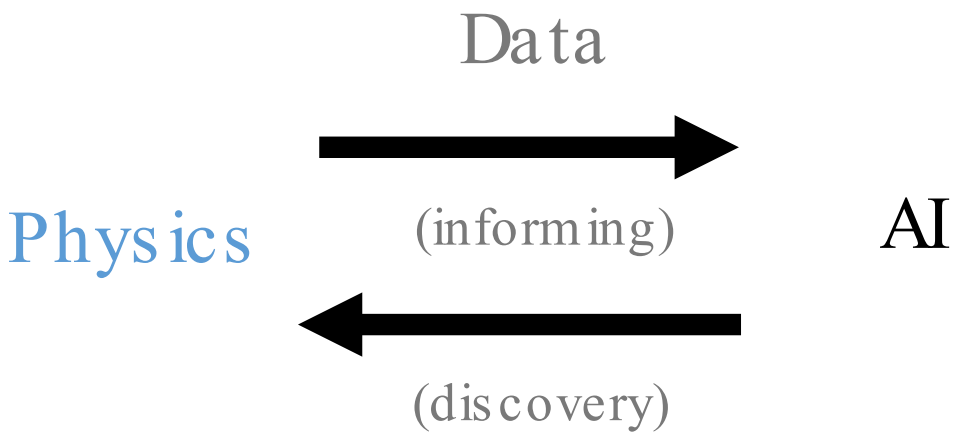




Combining physics and deep learning for diagnostic and prognostics?

Hybrid AI + Physics for Smart Maintenance

Physics captures what is known about the system, AI model discovers the system unknown features

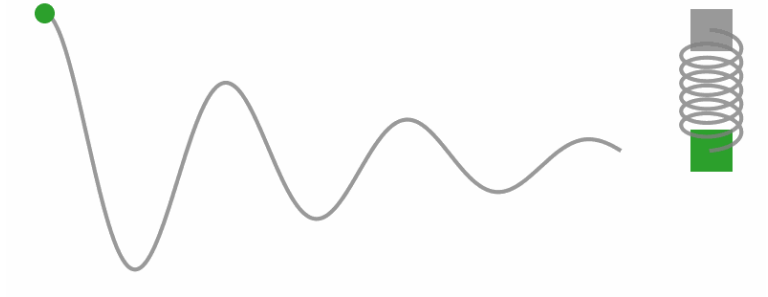


Less training data

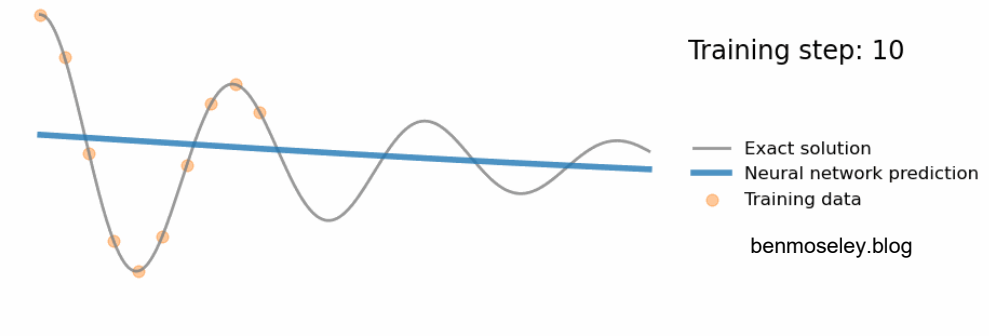
Better interpretability

…without sacrificing performance

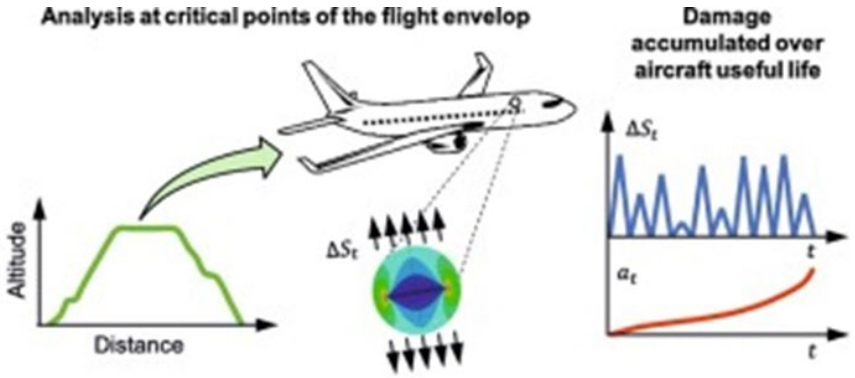
Hybrid Physics-informed Neural Networks



Neural Networks



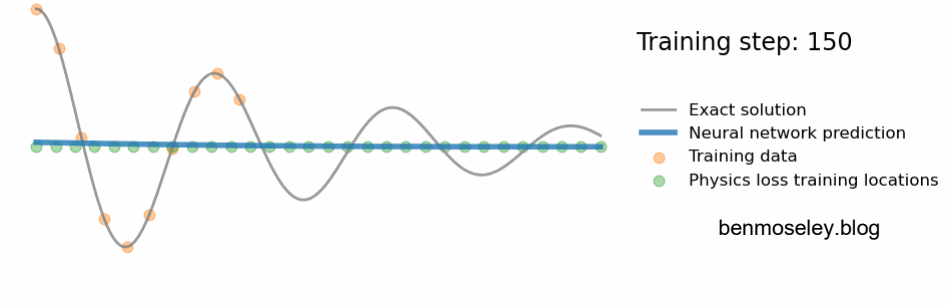
e.g. Prognostics –
fatigue of aircraft fuselage panels



Felipe A.C Viana et al, 2021

Physics-informed Neural Networks

$$m\frac{d^2u}{dx^2} + \mu\frac{du}{dx} + ku = 0$$



Improved ability to predict complex dynamics also with less training data