Rolls-Royce@NTU Corporate Lab

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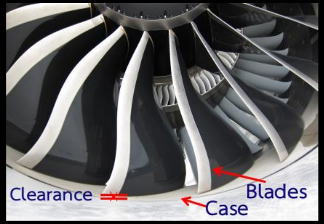
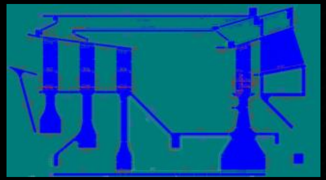
AI FOR TIP CLEARANCE DESIGN

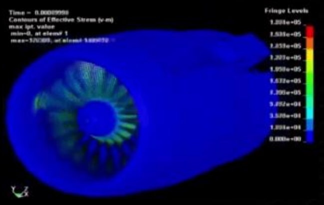
Overview



Tip clearance is the distance between the tip of a rotating airfoil and a stationary part.



Thermal and mechanical growths occur during the engine operating conditions.



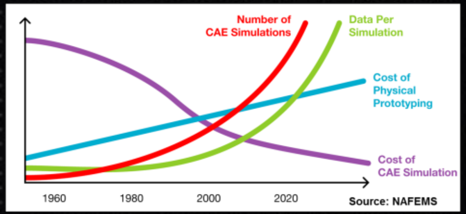
Poor design affects engine efficiency, operational temperature, and components.

Value proposition

- Quality improvement
- Design at pace
- Cost saving

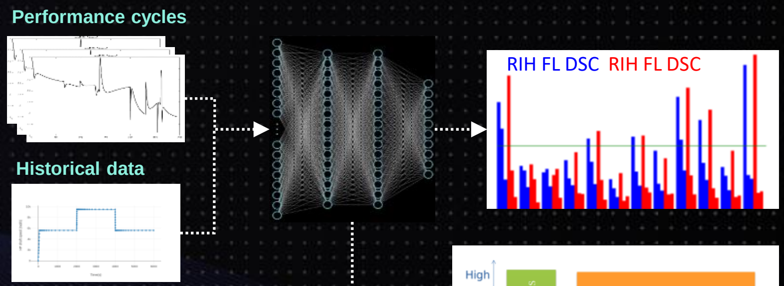
Challenges

- Thermal-mechanical simulations are expensive to run (10 -15 days).
- Lots of manual calibrations involved.
- Difficulty in accessing huge amount of simulation data.
- Current practices are limited to specific use cases.



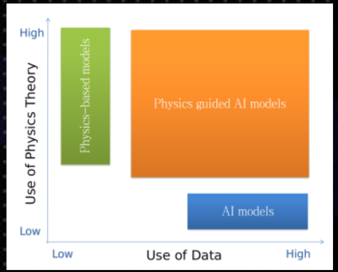
AI approach to simulation

- AI (Black box) methods can learn dynamics of tip clearance solely from data.
- Minutes to learn and seconds to predict.
- Huge number of examples is critical to success.
- Difficult to relate back to the underlying physics.



Challenges

- Physics theory + AI = physically meaningful results + generalizability.
- Need less examples for learning.
- Support verification and validation.



Further extensions

- Seal clearance at marginal cost.
- Predict behaviour of new design variations at pace.
- Adapt for other phenomenon - stress & life, dynamics, etc.