AI Opportunities in Gas Turbine Diagnostics

Dr Yiguang Li PhD, MSc, BSc, ASME FELLOW, HEA FELLOW
Reader in Gas Turbine Technology
Director of Gas Turbine Performance and Diagnostics Applications
Centre for Propulsion Engineering
School of Aerospace, Transport and Manufacturing, Cranfield University
Cranfield University
Cranfield, Bedford MK43 0AL, UK

Artificial Intelligence

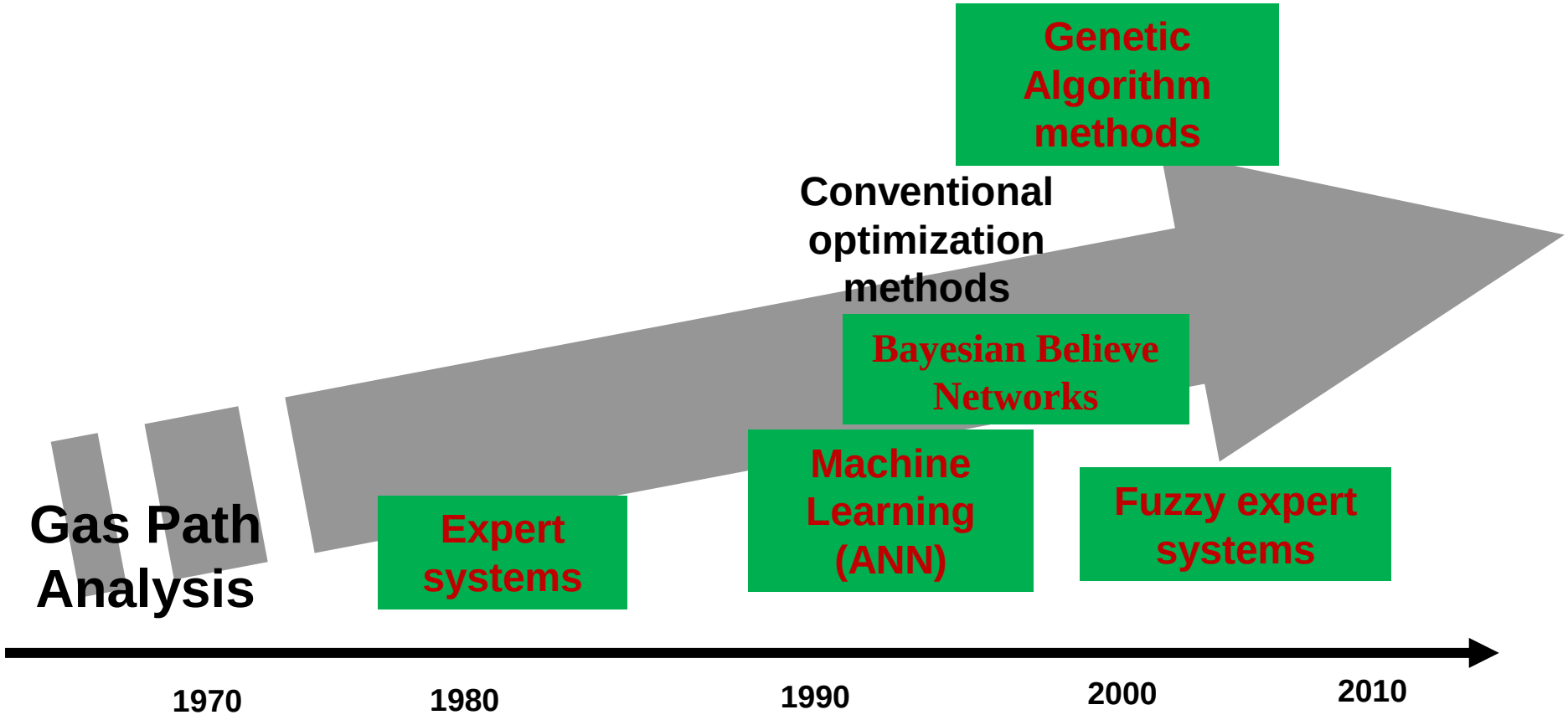
The simulation of human intelligence in machines that are programmed to think and mimic human cognitive functions.

AI Methods in *GT diagnostic applications*:

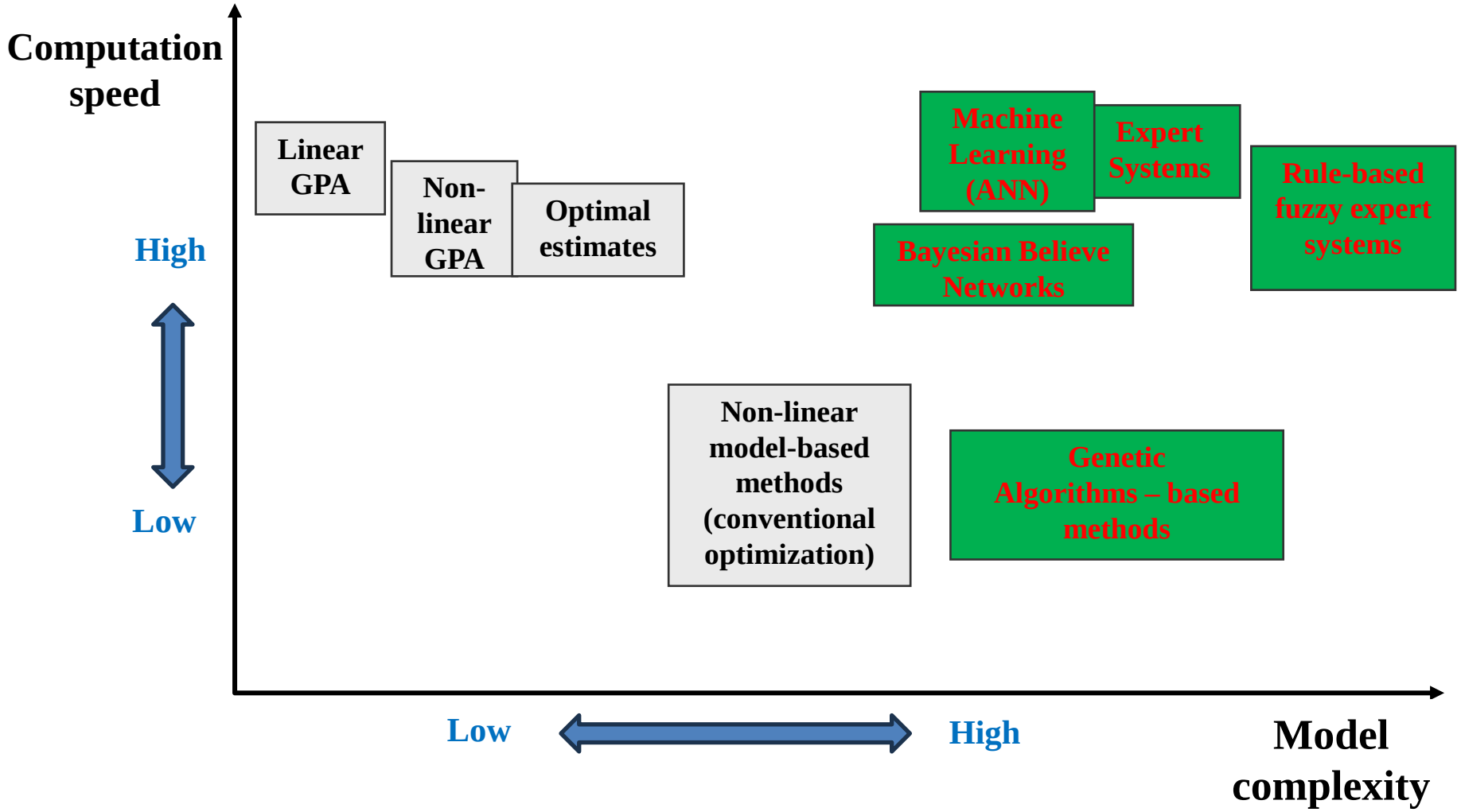
- **Machine Learning** (**Supervised**, unsupervised & reinforcement, **deep learning**)
- **Rule-based systems (Expert Systems)**
- **Bayesian Believe Networks**
- **Evolutionary Algorithms (Genetic Algorithms)**
- **Fuzzy Logic**
- **Decision trees**
- **Hybrid methods**
- **Natural Language Processing (NLP)**
- **Computer Vision**
- etc.

- **Fentaye A, et al., "A review on gas turbine gas-path diagnostics: state-of-the-art methods, challenges and opportunities", Aerospace, Vol. 6, No. 83, 2019.**
- **Li Y. G., "Performance-Analysis-Based Gas Turbine Diagnostics: A Review", IMechE Journal of Power and Energy, Vol. 216, No. A5, 2002.**

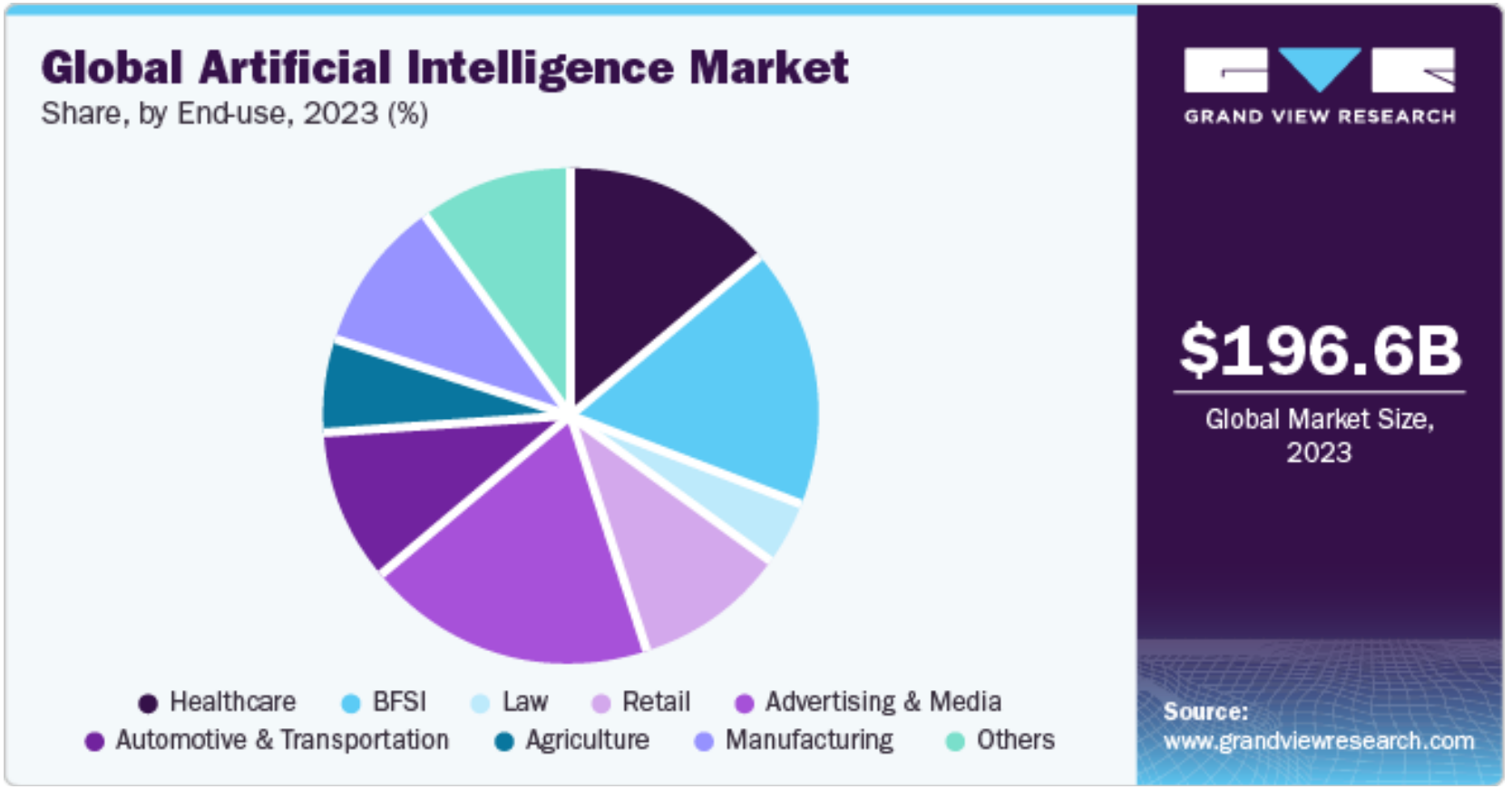
History & Development



Capabilities & Comparisons



AI Market & Potentials



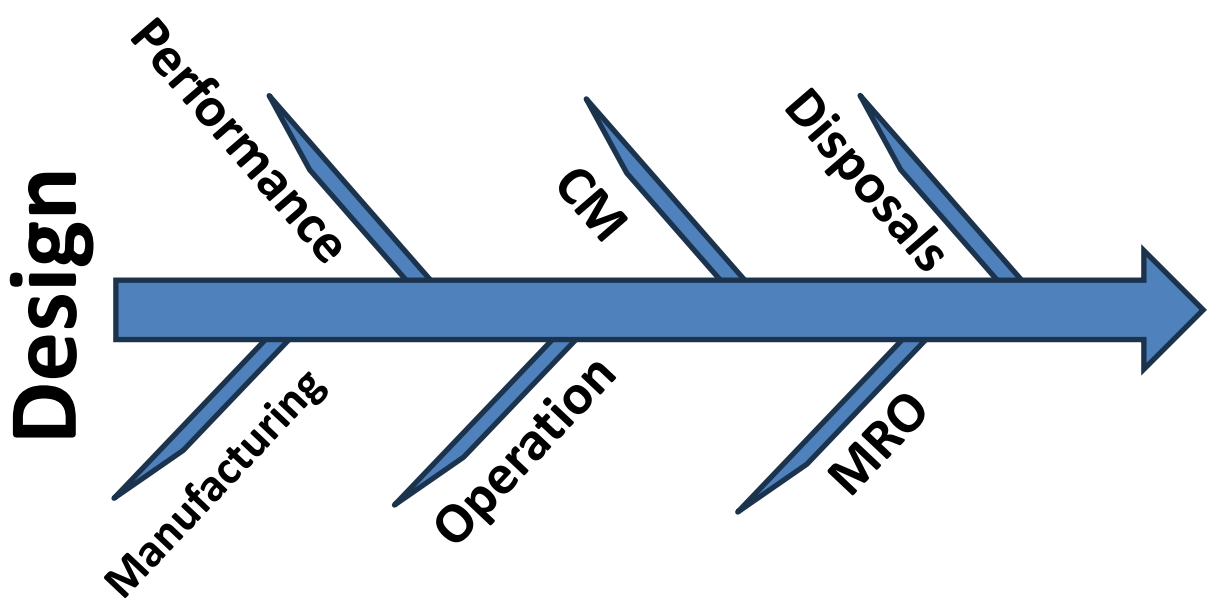
Artificial Intelligence Market Size, Share & Trends Analysis Report By Solution (Hardware, Software, Services), By Technology (Deep Learning, Machine Learning, NLP), By Function, By End-use, By Region, And Segment Forecasts, 2023 – 2030 (https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-market# accessed on 5/3/2024)

AI Opportunities

AI is particularly useful when physical models are not available, or too complicated, or dealing with multi-discipline problems

GT Digital Twins

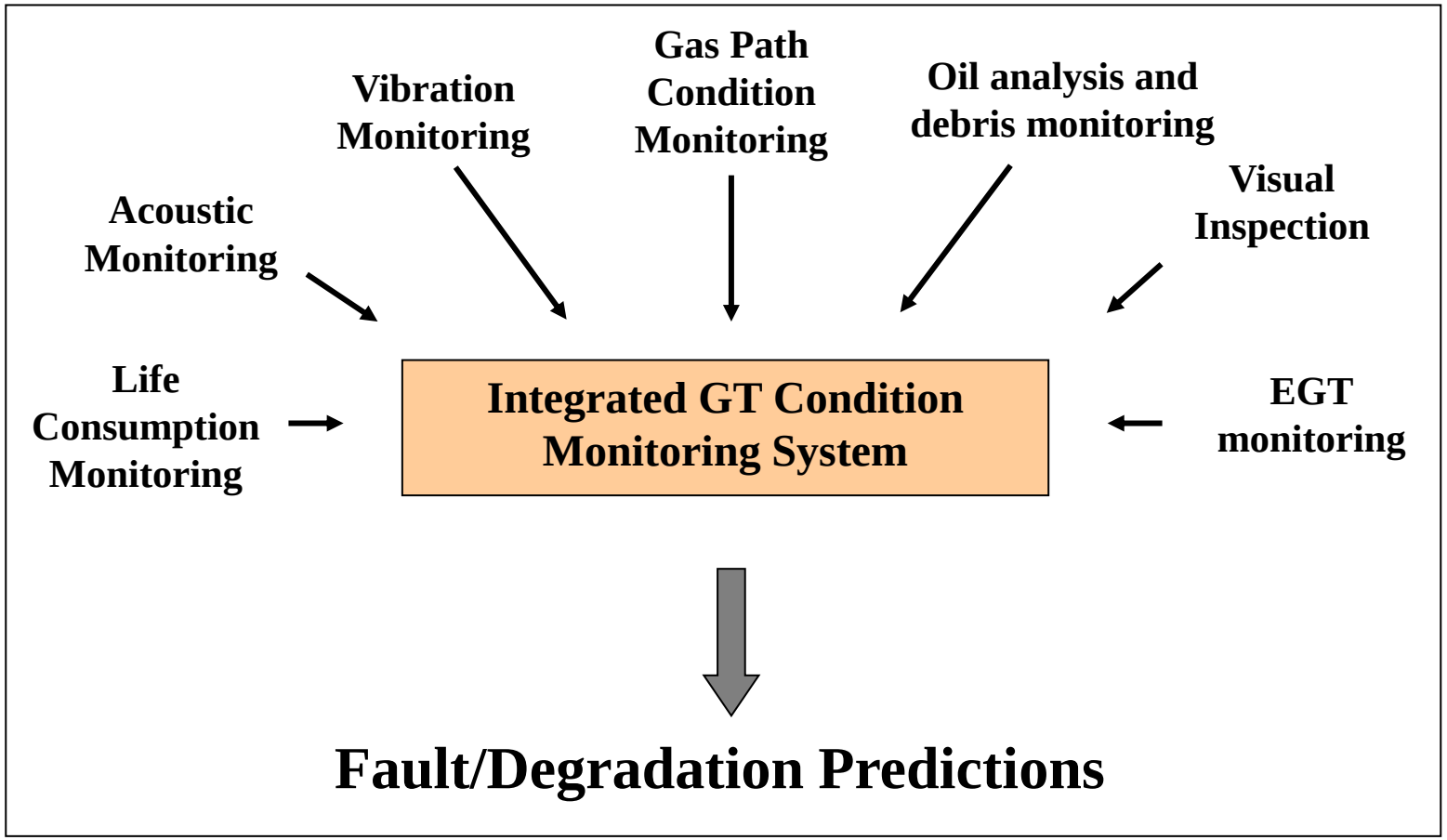
Digital representation of physical objects, processes, systems, etc. for the whole life cycle



https://www.digitalengineering247.com/article/digital-twins-evolving-footprint

AI Opportunities

AI is particularly useful when physical models are not available, or too complicated, or dealing with multi-discipline problems



AI Opportunities

AI is particularly useful when physical models are not available, or too complicated, or dealing with multi-discipline problems

From Preventive to Predictive Maintenance

GT Owners

MRO Industry

R&D

➢ **BENEFITS**:

- Better predictability
- Higher plant availability
- Lower maintenance costs

➢ **TECHNICAL CHALLENGES**:

- Multi-disciplines
- Technology and expertise
- Reliability of predictions
- Complexity in scheduling / management

Thanks for your attention

Dr Yiguang Li PhD, MSc, BSc, ASME FELLOW, HEA FELLOW
Reader in Gas Turbine Technology
Director of Gas Turbine Performance and Diagnostics Applications
Centre for Propulsion Engineering
School of Aerospace, Transport and Manufacturing, Cranfield University
Cranfield University
Cranfield, Bedford MK43 0AL, UK