Application of Machine Learning for Fatigue and Fretting Fatigue

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Fracture Fatigue and Wear

Fatigue failure is a very important topic in the Material and Engineering field

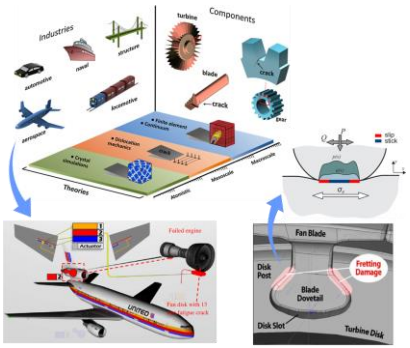


Fig.1. Fatigue-induced component failures in modern industries and the approaches used in fatigue field [1,2]

The future trend: Data-Driven Science

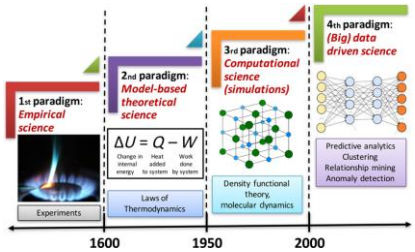


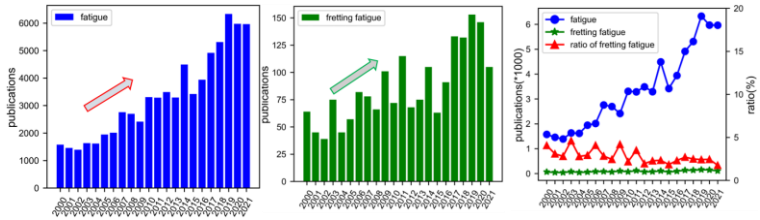
Fig.2. The four paradigms of science in the context of materials[3].

Advantages of Machine Learning (ML) in fatigue :

1. Ability at big data, good balance at speed and accuracy.
2. Ability at obtaining nonlinear abstract relationship directly from complex multi-dimensional random data.
3. Ability at discovering unknown physics from data, and generalizing well to unseen data.

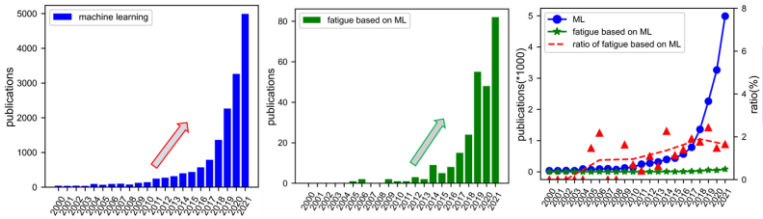
I

The rapid development of fatigue in the material and engineering field



Method:
Search the string "*fatigue*", "*fretting fatigue*" "*machine learning*" and "*machine learning + fatigue* " separately in *Web of Science* within restricted field "Material science multidisciplinary" "Engineering mechanical" "Engineer multidisciplinary"

The rapid development of machine learning (ML) in the material and engineering field



Application of machine learning (ML) in fatigue field requires more attention!

III

Artificial neural network (ANN) is the most popular Machine learning method in fatigue field, is the most frequently used model for fatigue life estimation [4,5]

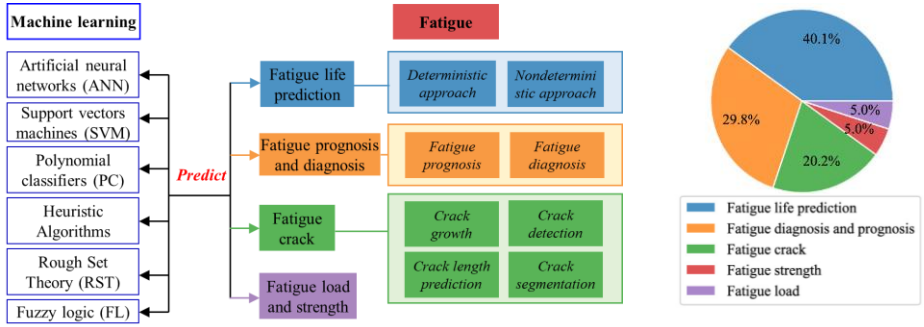


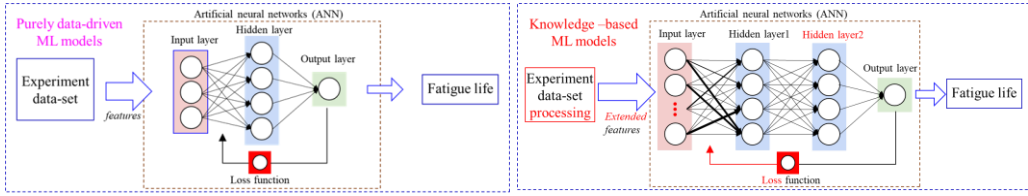
Fig.3. Application of ML for fatigue [4,5] (a) ML methods used in fatigue field (b) statistics of ANN usage

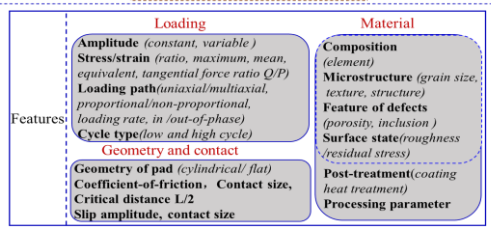
II

Advantage: without requiring a thorough understanding mechanism

Advantage: higher accuracy, better robustness, improved extrapolation

IV





Current Limitations:

V

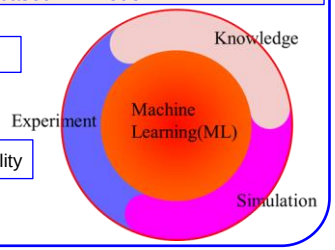
1.Requirement of big data.
2.Lack of direct and in-direct data
3.Black box and low interpretability

Future Potential : Couple simulation to knowledge-based ML model

Relieve data hungry

Richer input data

Improve interpretability



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