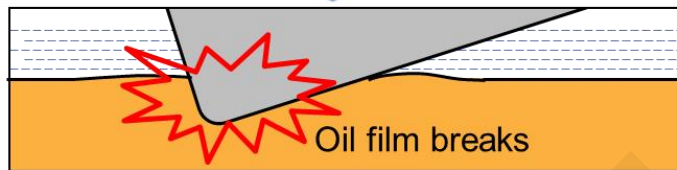
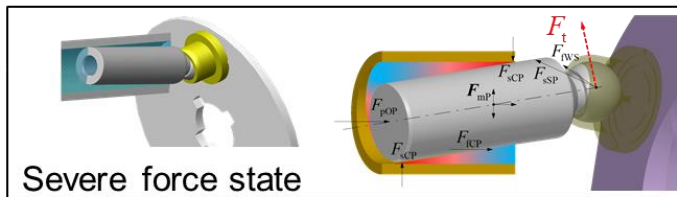


Wear map-based wear prediction method for the piston–cylinder interface in axial piston machines

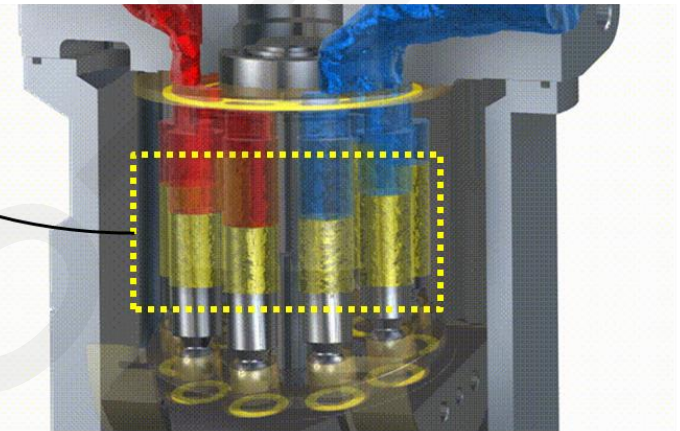
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Background & Motivation



Piston/cylinder interface (PCI)



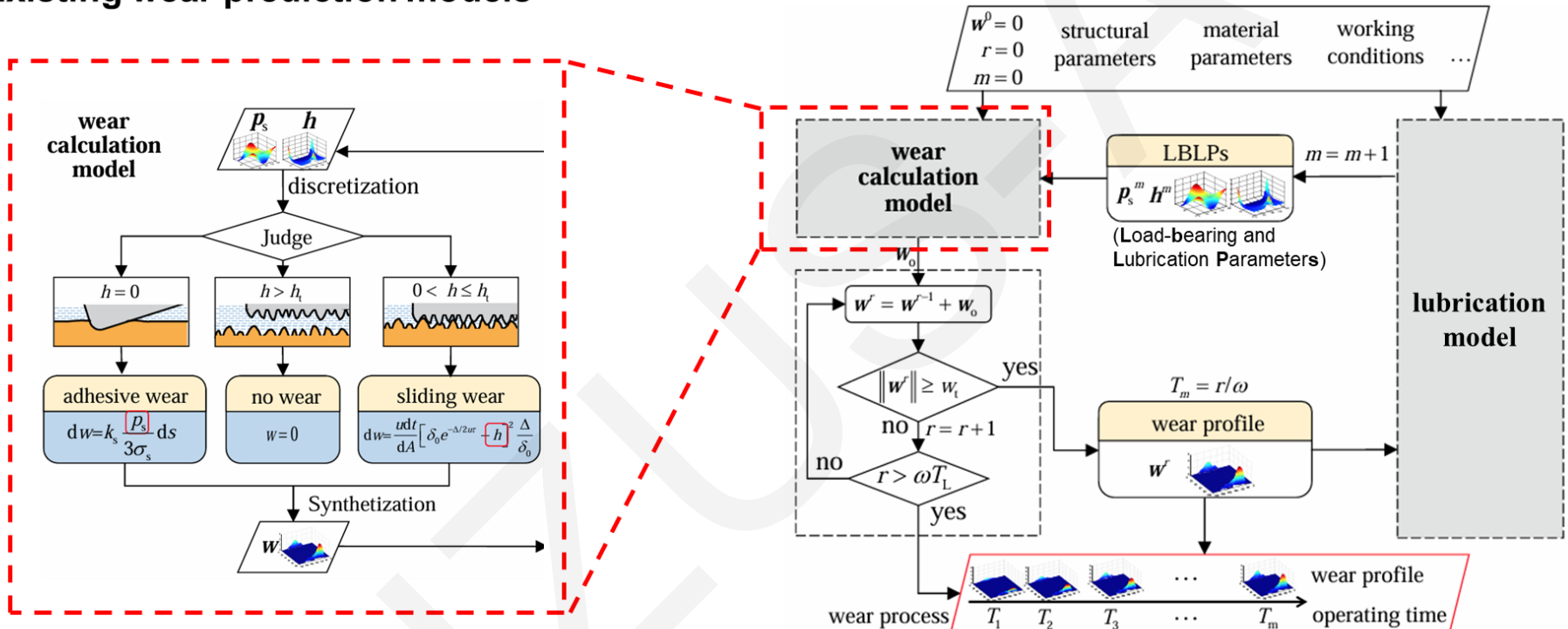
Axial piston machine (APM)

Efficiency decrease
Fluid contamination
Abrupt failure of the system
...

Research objective: Predicting the wear process to enhance the performance and reliability

Background & Motivation

Existing wear prediction models



Hard switch method is too idealistic in both wear judgment and calculation

Lyu, et al. *Wear*, 2020

Challenges: Obtaining accurate lubrication regimes and using the appropriate wear mechanisms

Method

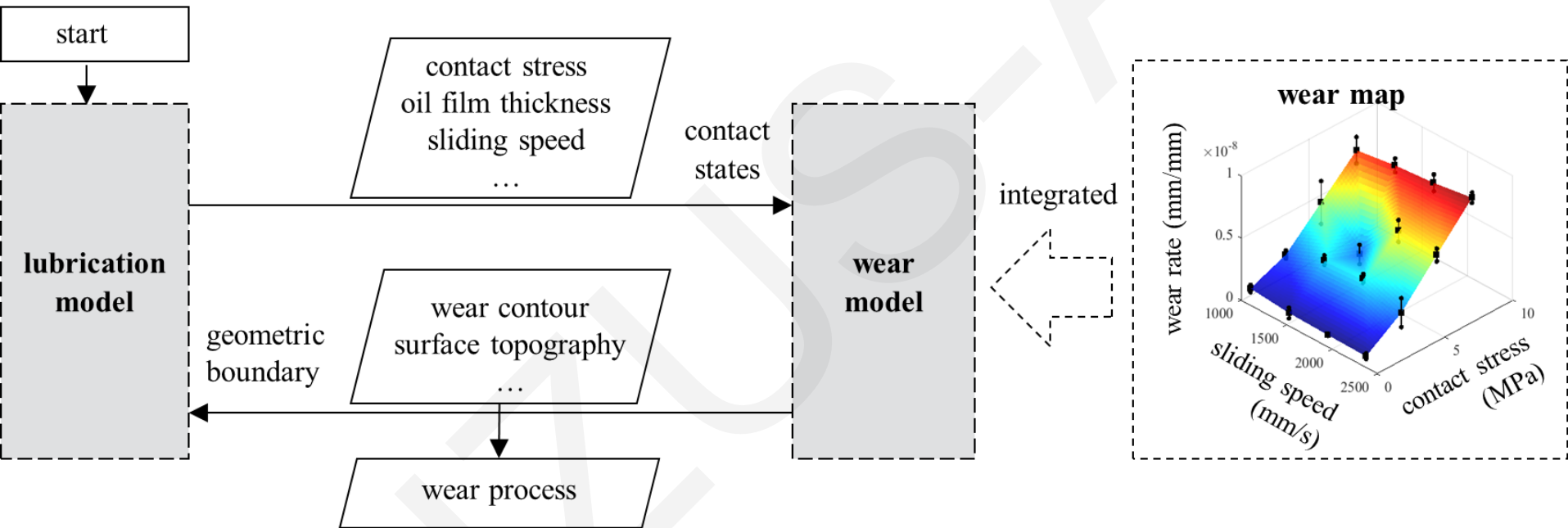


Fig. 2 Brief flowchart of the PCI wear prediction method

Experiments

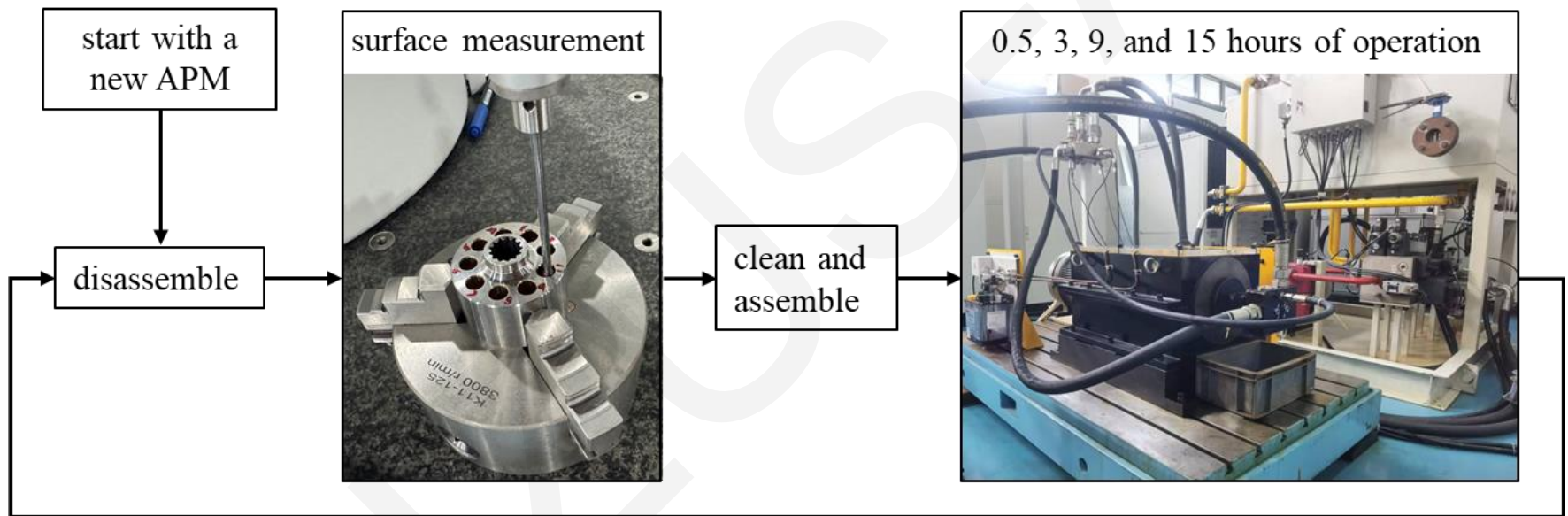


Fig. 10 Process of the APM wear test

Results

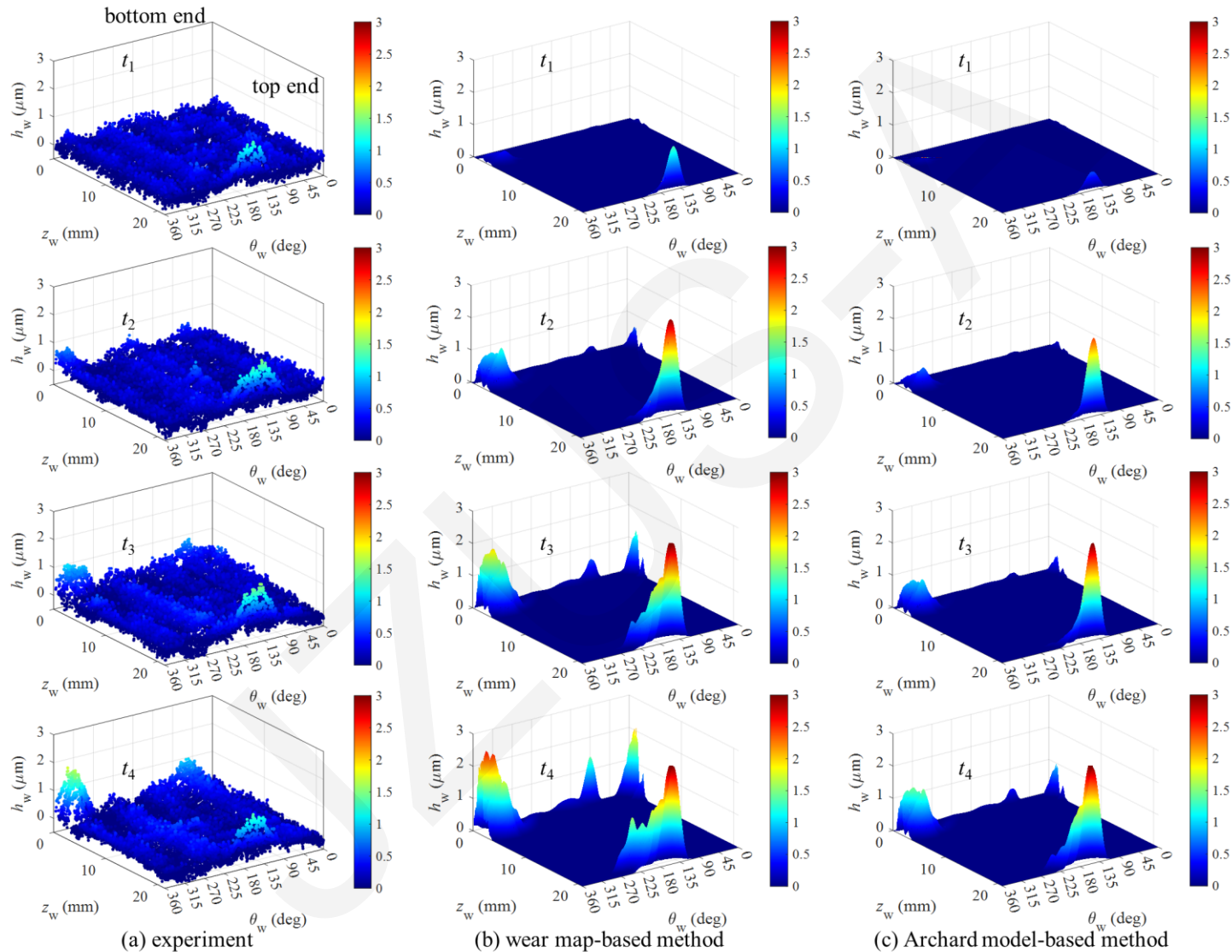
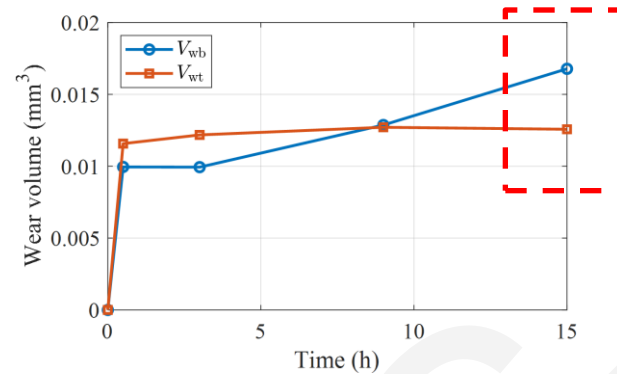


Fig. 11 Evolution of the PCI wear contour predicted by different approaches: (a) experimental method; (b) wear map-based method; (c) Archard model-based method

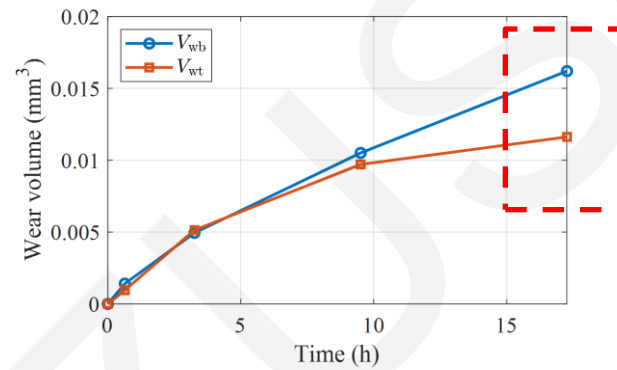
Results

(a) experiment



The wear map-based method captured this redistribution more consistently

(b) wear map-based method



(c) Archard model-based method

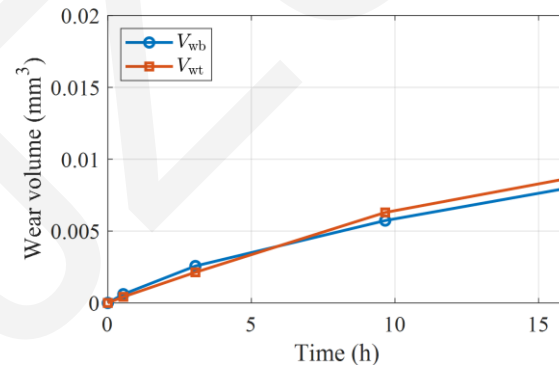


Fig. 12 Quantitative evolution of the wear volumes at top end and bottom end: (a) experimental method; (b) wear map-based method; (c) Archard model-based method

Conclusions

- The wear map-based method has the capability to predict the wear behavior at the PCI with multiple coexisting contact states. Targeted engineering implications can be drawn.
- Candidate material pairing and surface condition for the PCI in APMs can be screened by initial disk-on-disk tribometer tests combined with wear prediction, without the immediate need for APM prototyping.
- For existing APMs, a more targeted and physics-consistent wear prediction can be provided to support predictive maintenance.