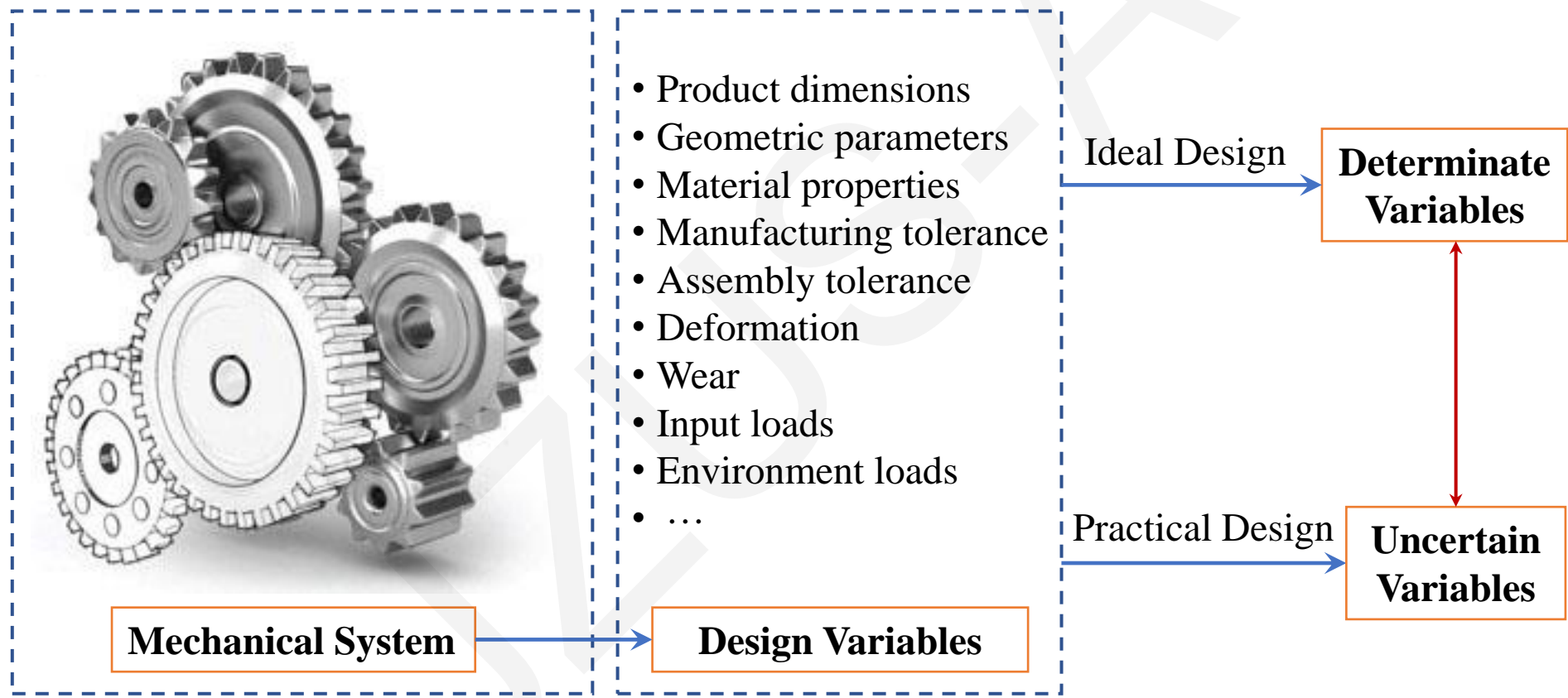


Reliability measure approach considering mixture uncertainties under insufficient input data

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Determinate Variables and Uncertain Variables



Uncertainty Types Due to Insufficient Input Data

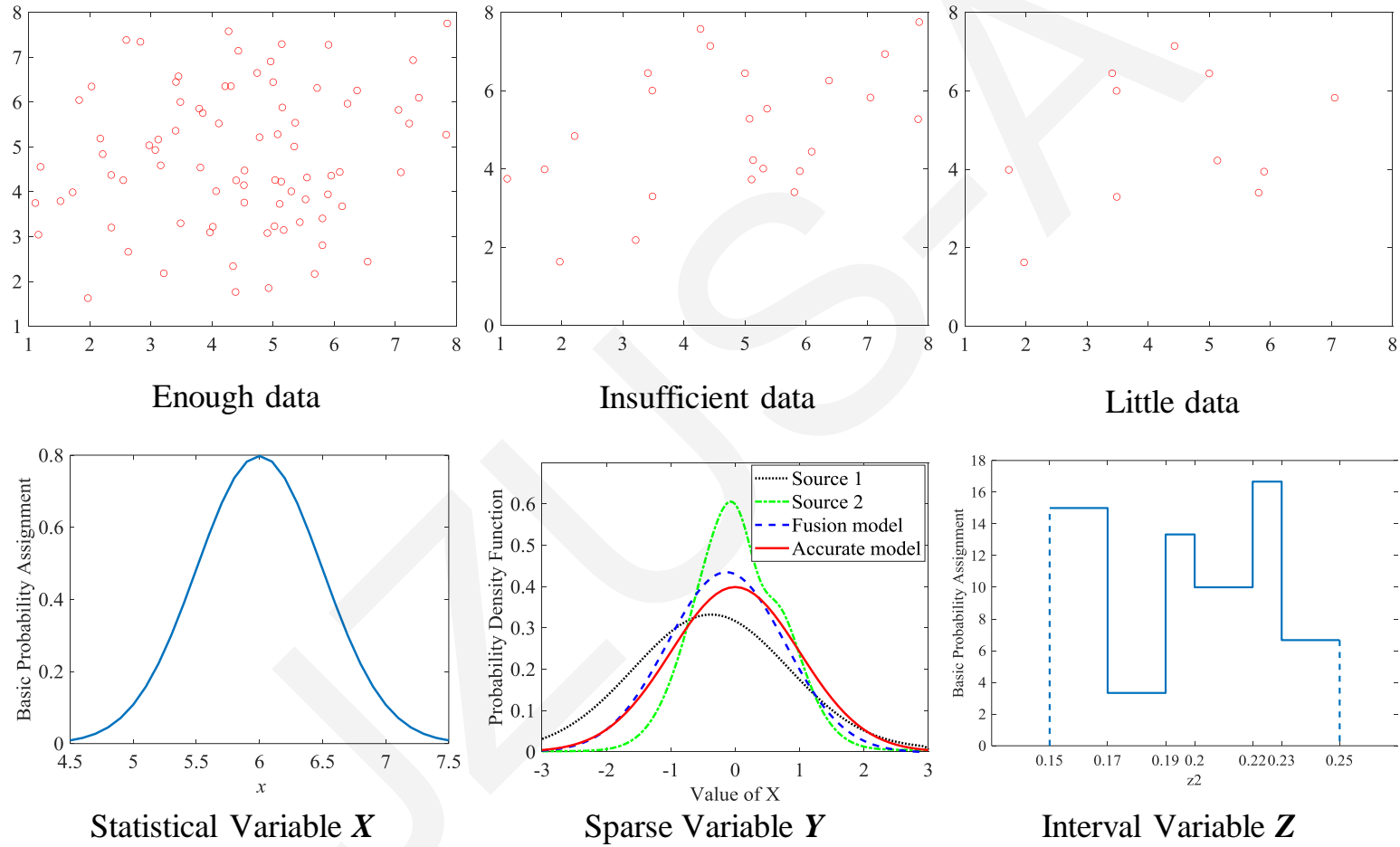


Fig 1. Multiple uncertainty types due to insufficient input data

Main Method

- **Statistical Variables X ,**
- **Sparse Variables Y ,**
- **Interval Variables Z**

Unified Calculation of Probability of Failure Probability

Sensitivity Analysis of Reliability Index

Extension to More Uncertainty Presentation Types

- **p -box uncertainty variables**
- **Multi-modal distribution variables**
- **Evidence theory variables**

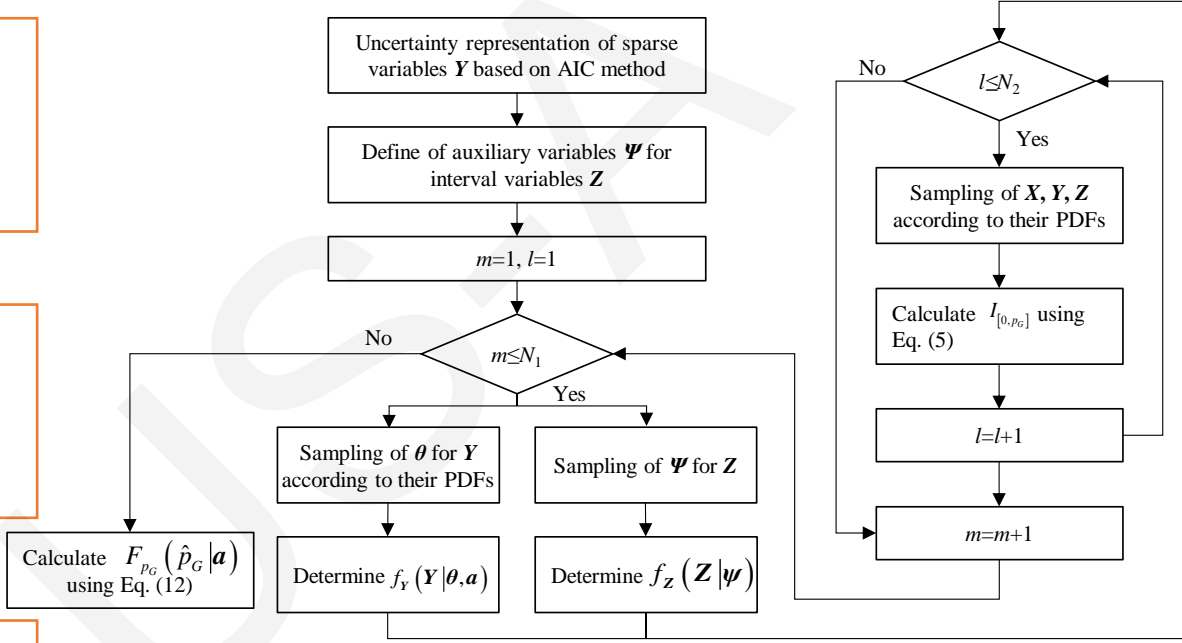
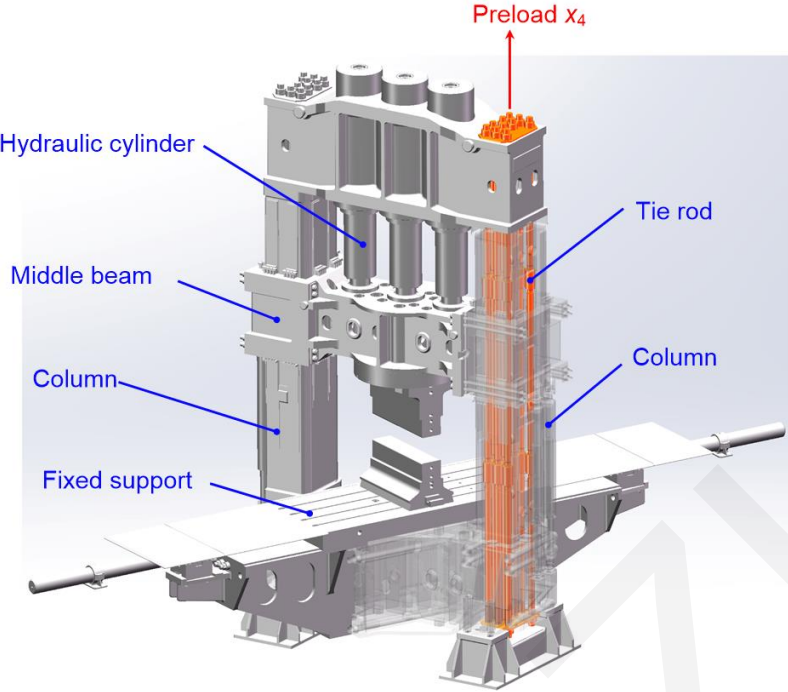


Fig. 2 Calculation flow chart for failure probability

Engineering Example: Forging Hydraulic Press



- The load of the hydraulic press x_1
- The diameter of tie rods x_2
- The Young's modulus of tie rods x_3
- The preload acting on tie rods x_4

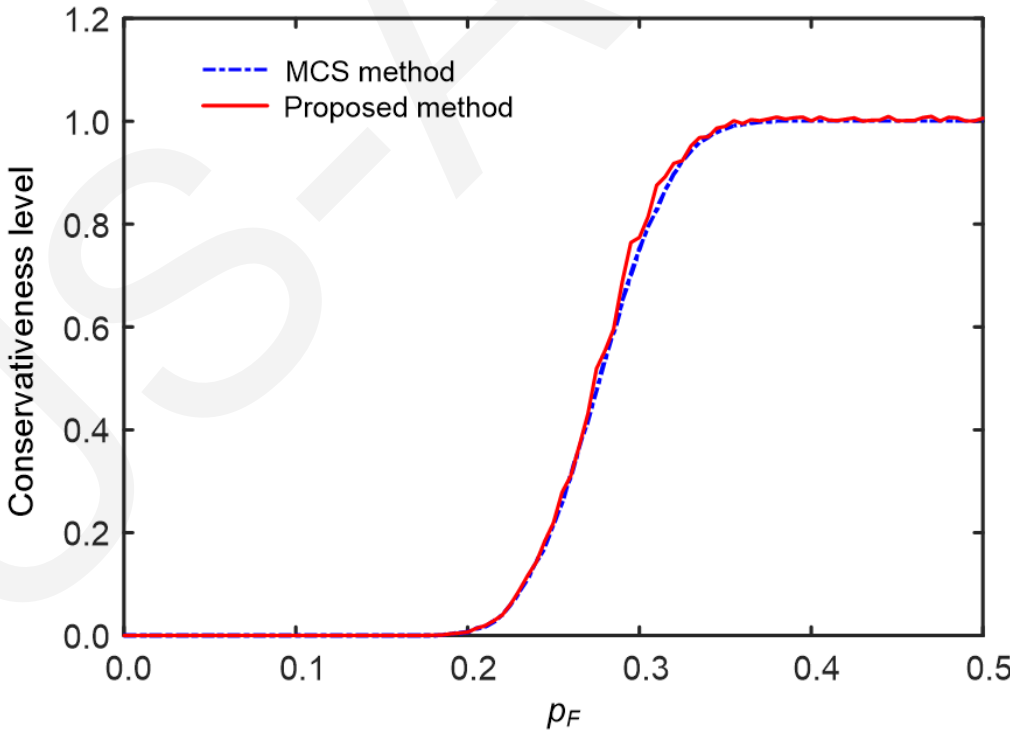


Fig. 13 Reliability result of forging hydraulic press

Engineering Example: Forging Hydraulic Press

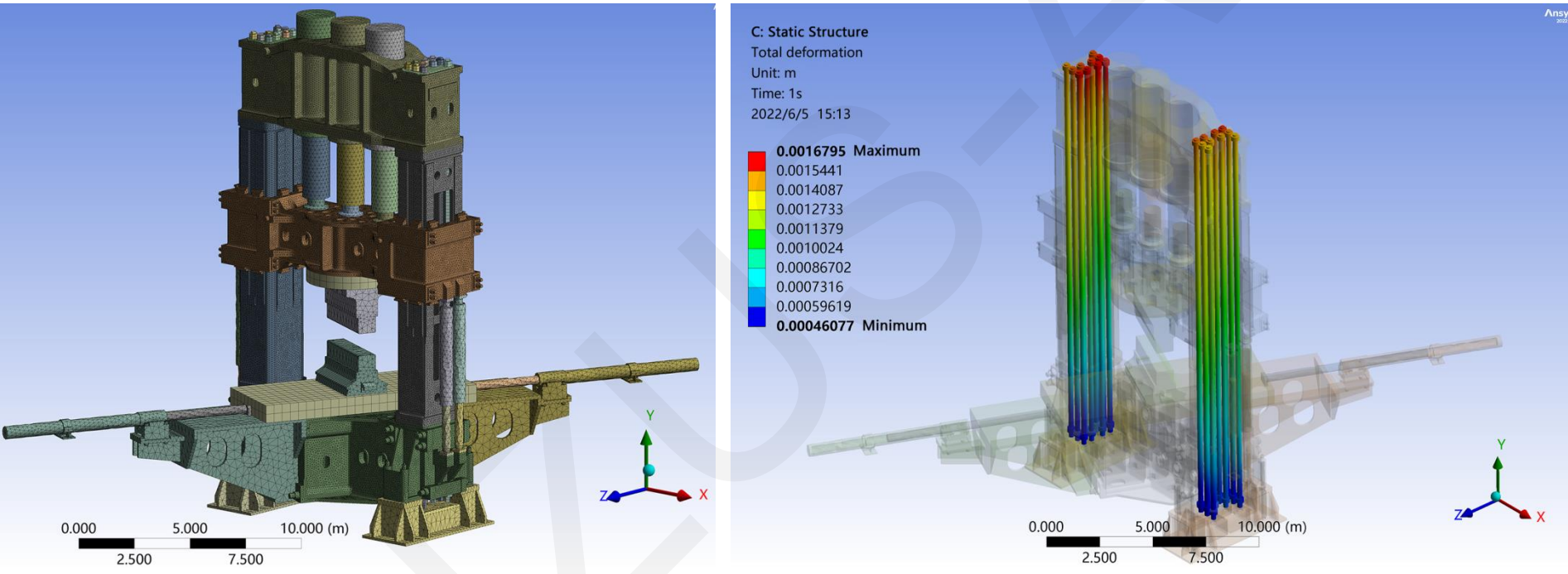


Fig 11. FEA of the forging hydraulic press: (a) mesh; (b) deformation of the tie rods

Conclusions

In this study, a reliability measure approach considering mixture uncertainties under insufficient input data is proposed.

- First, the sparse variable is represented using weight summation of multiple distribution types based on AIC method under insufficient input data.
- Second, the failure probability under mixture uncertainties is calculated using the proposed two-level sampling method. Then, a semi-analytical method is proposed to calculate the sensitivity indices of mixture uncertainty variables.
- Finally, the proposed reliability measure method is extended to deal with p -box variables, multi-modal variables, and evidence theory variables.