

# Fretting Damage Evolution of Steam Generator Tubes Under Coupled Clamping Force and Clearance Conditions

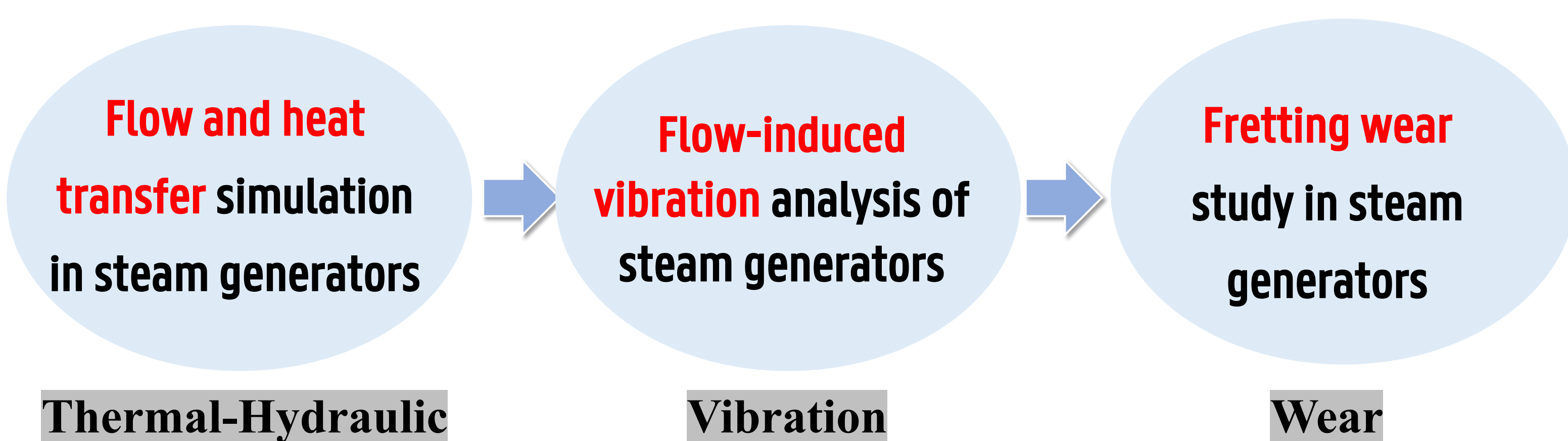
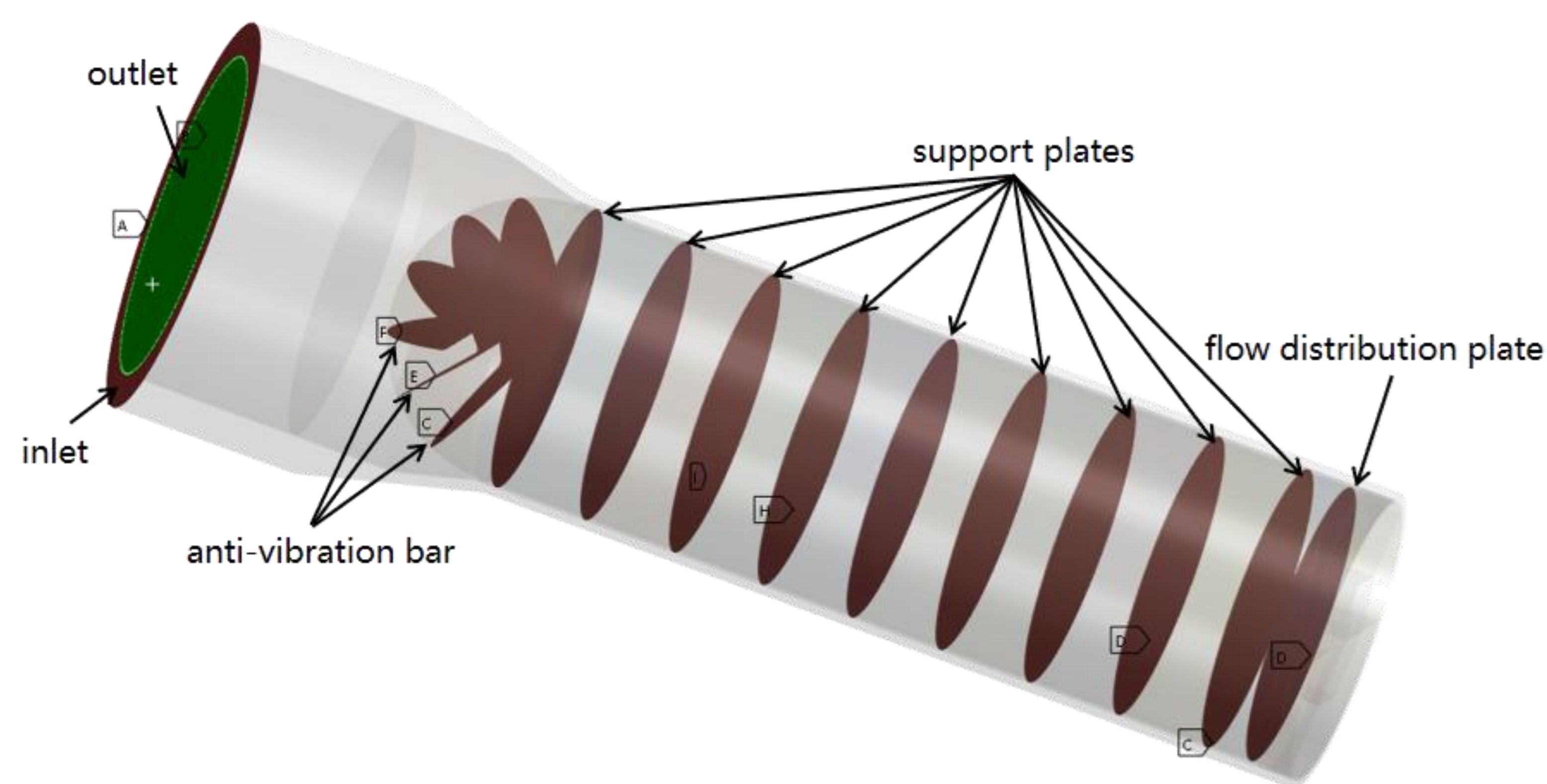


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## Introduction

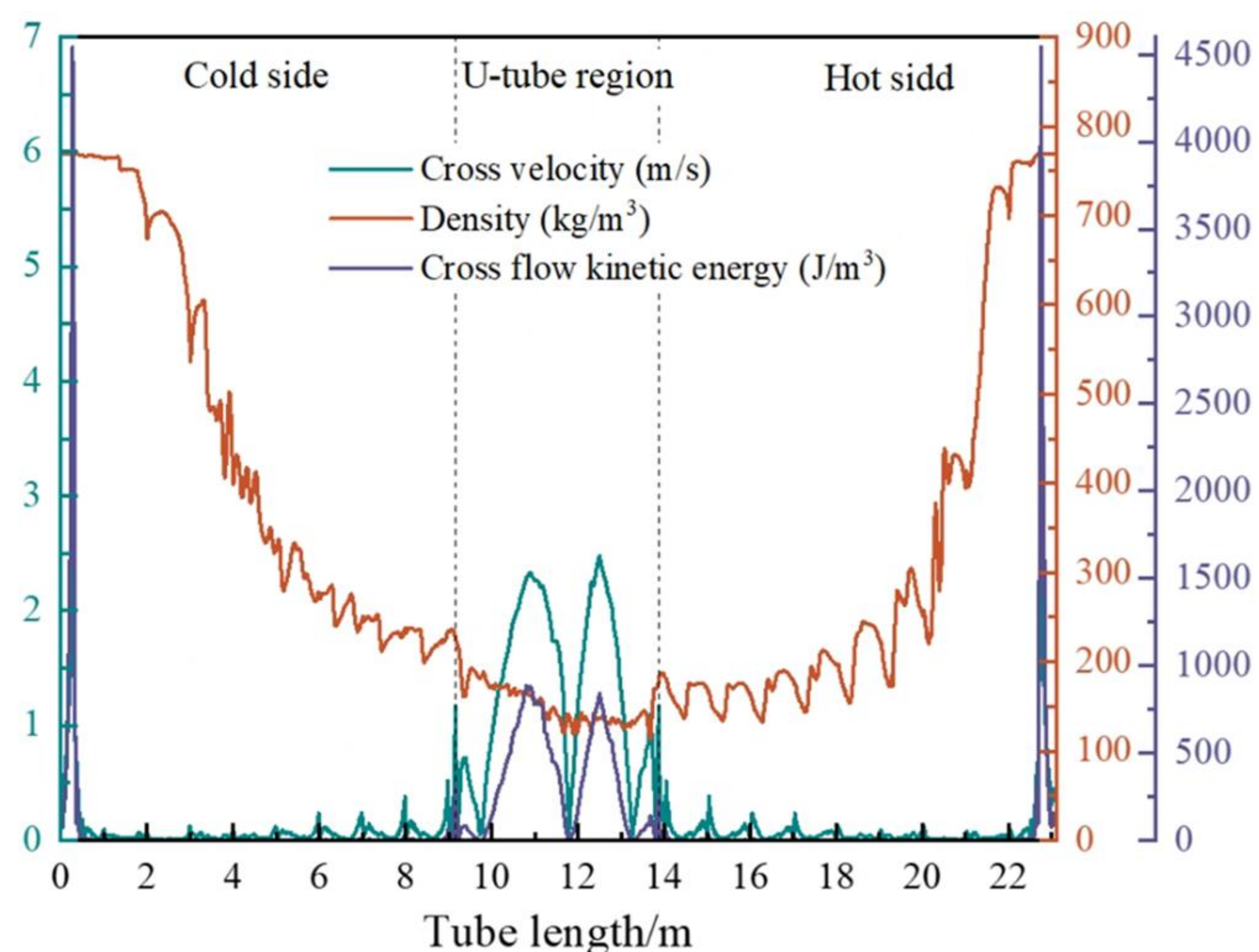
A dynamic analysis model of the tube-support system is established by considering contact nonlinearity, friction effect, and clearance characteristics. The contact force, relative displacement, impact behavior, and damage evolution characteristics of steam generator tubes under different clamping force and clearance conditions are investigated. Furthermore, the influence mechanism of clamping force and clearance on contact-state transition, energy dissipation, and fretting damage sensitivity is analyzed, and the evolution law of fretting damage under varying structural constraint parameters is discussed.

## Methods



## Graphics / Images

### ✓ CFD results

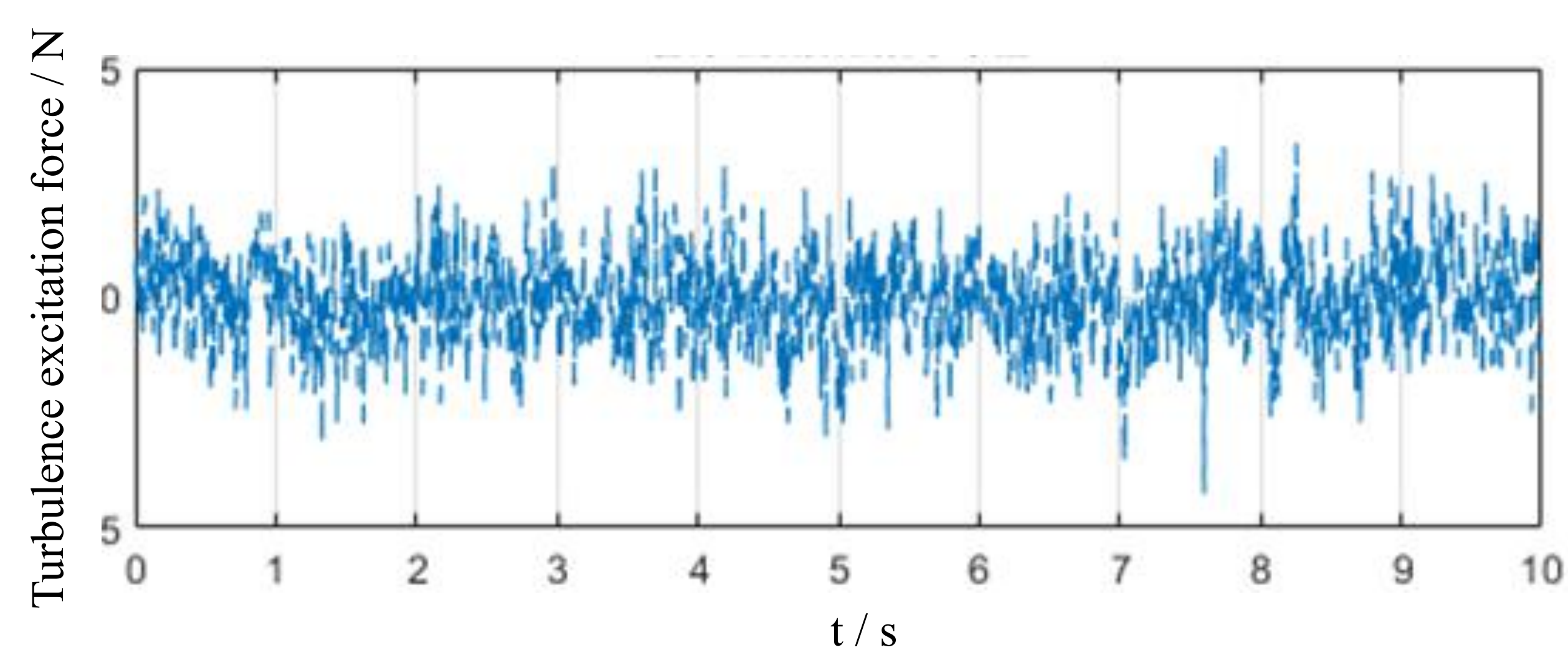


### ✓ PSD of Turbulence excitation force

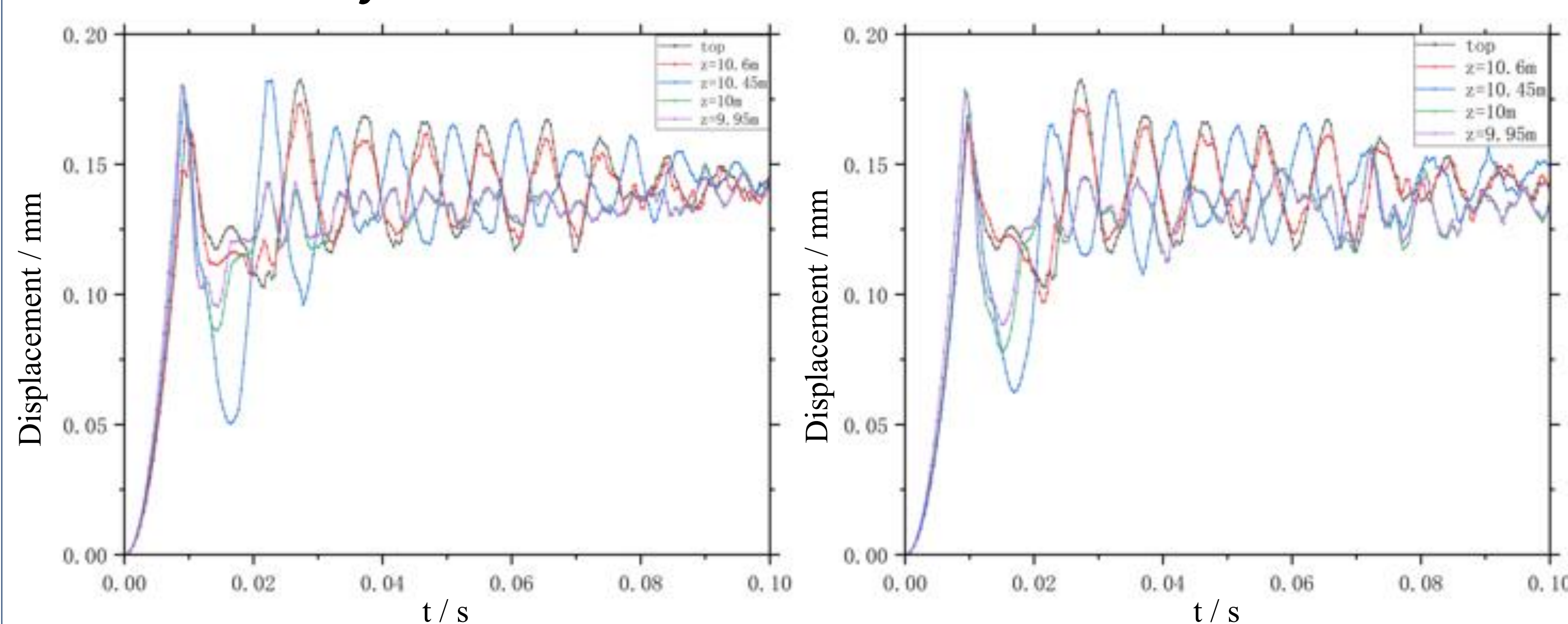
Lift force(Out-of-plane):

Drag force(in-plane):

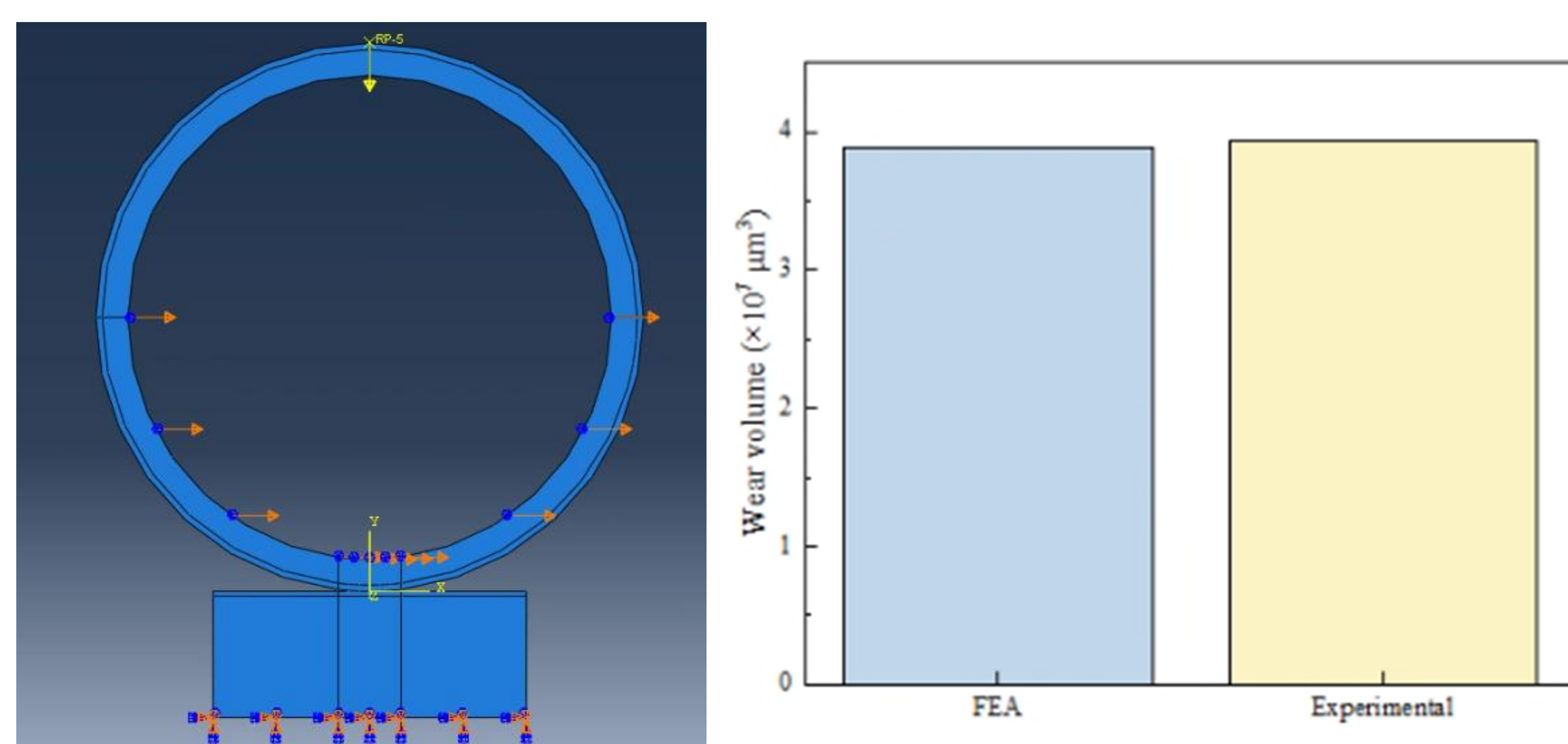
$$\phi_L = \begin{cases} 4.75 \times 10^{-3} S^{-0.4}, & S < 0.43 \\ 1.02 \times 10^{-4} S^{-5}, & S > 0.43 \end{cases} \quad \phi_L = \begin{cases} 7.35 \times 10^{-4} S^{-0.4}, & S < 0.53 \\ 3.69 \times 10^{-5} S^{-5}, & S > 0.53 \end{cases}$$



### ✓ FIV analysis



### ✓ Fretting wear model



➤ Coupling CFD with Porous Media Models

➤ Finite Element Method

➤ Archard Model