

# **Influence of yaw damper layouts on locomotive lateral dynamics performance: Pareto optimization and parameter analysis**

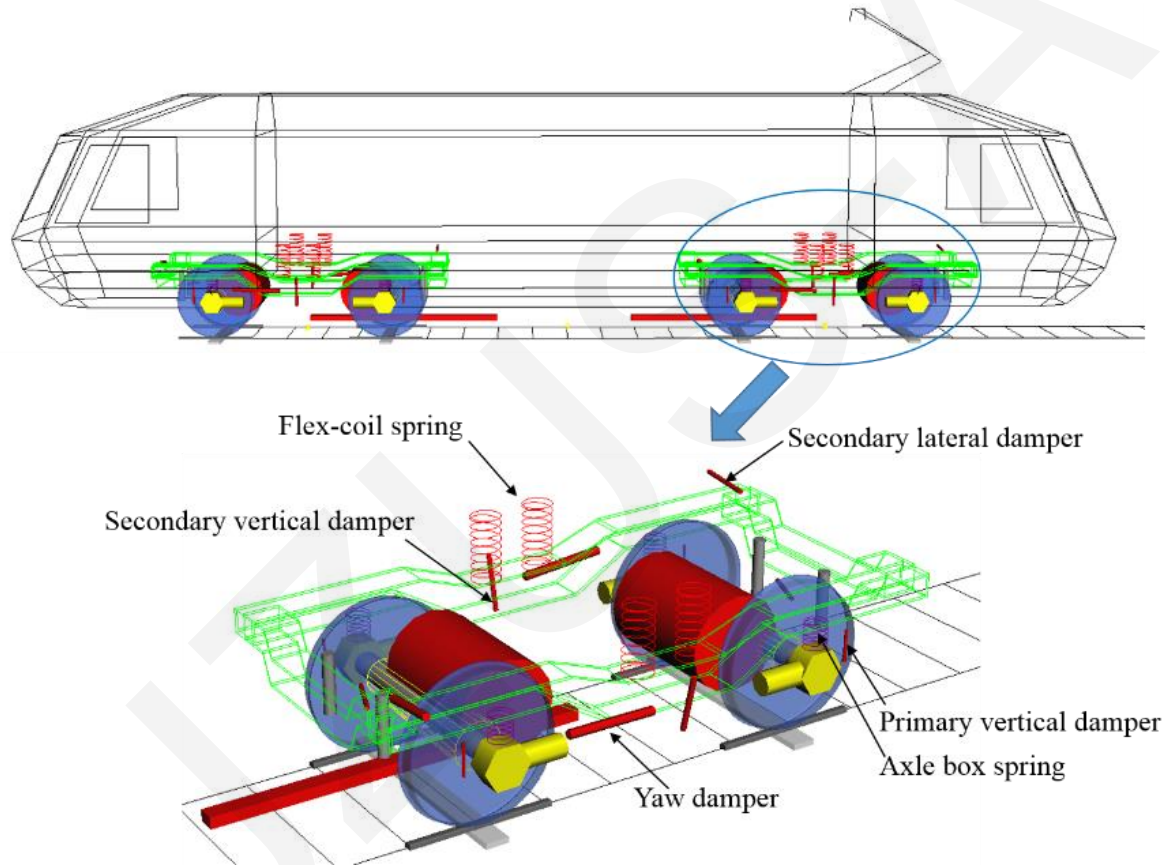
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# Multibody modelling

- A dynamic model considering nonlinear characteristics



**Fig. 1. High-speed locomotive dynamics model.**

# Multibody modelling

## ■ Four types of yaw damper layouts

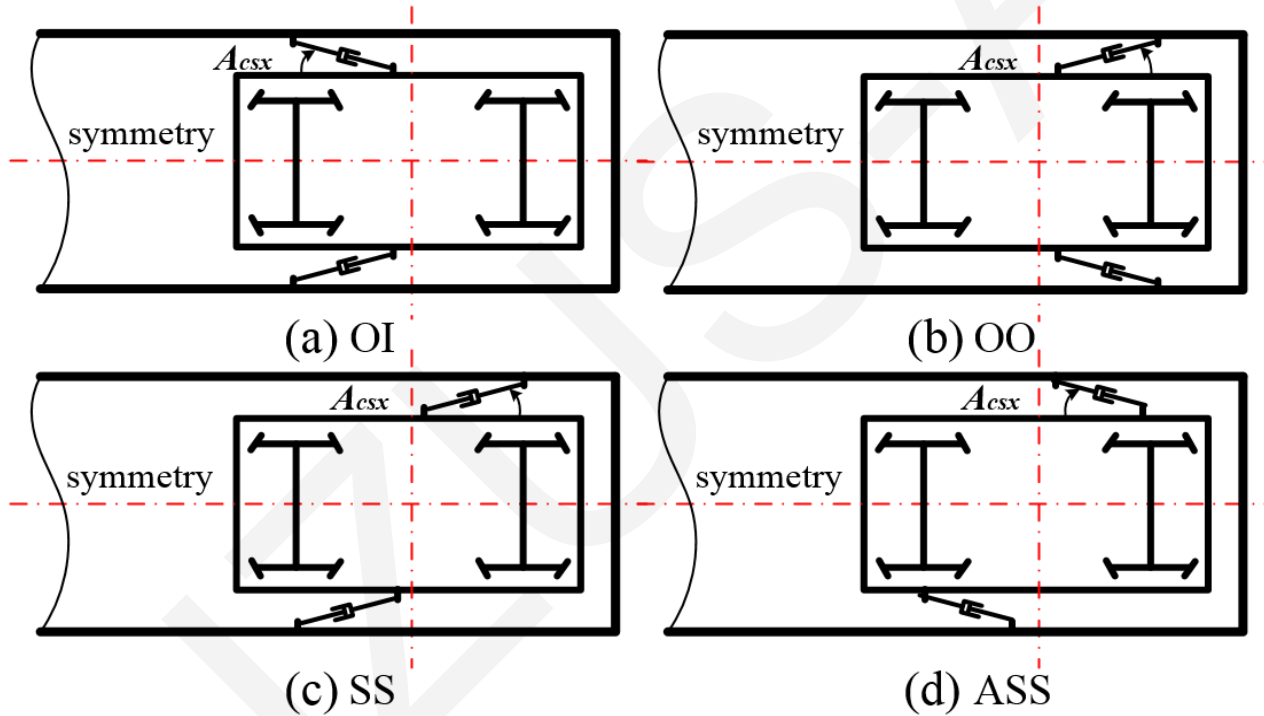
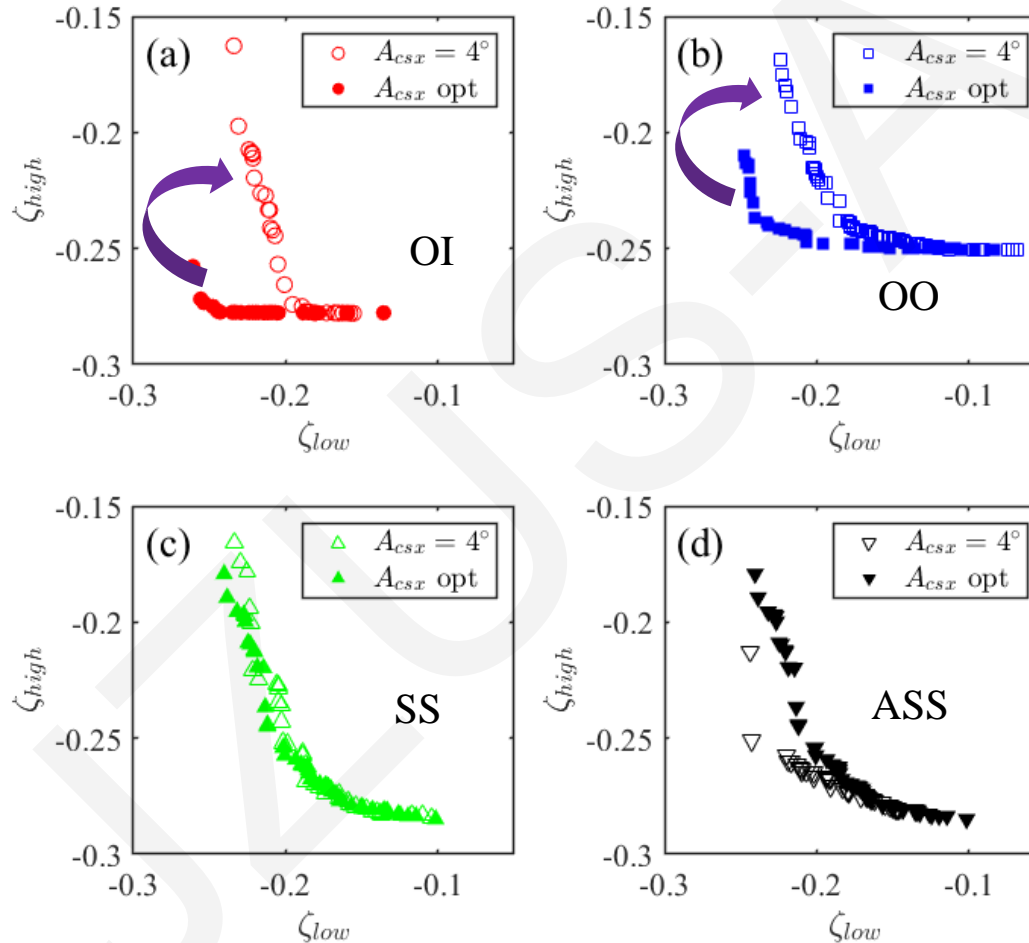


Fig. 2. The schematic diagram of yaw damper layout.

# Pareto optimization



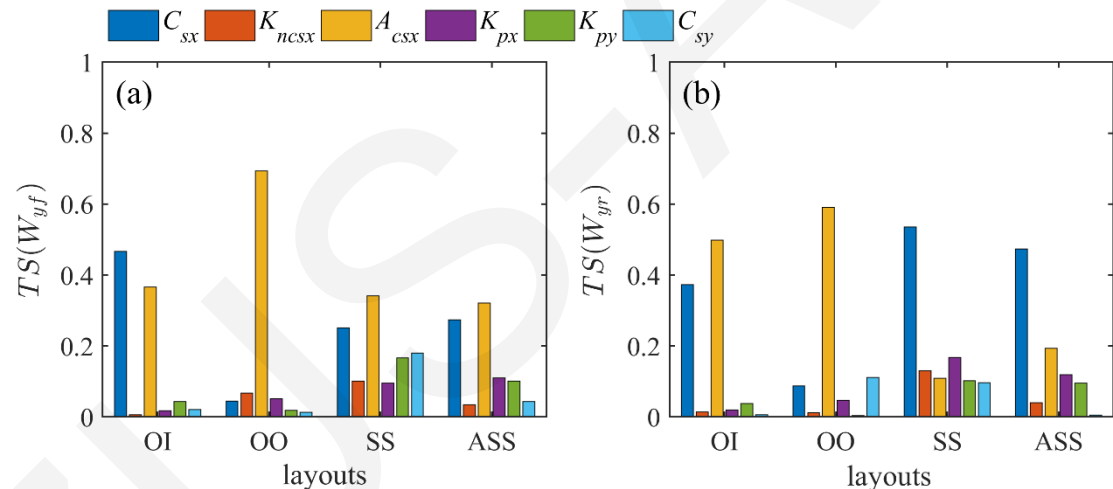
**Fig. 3. The Pareto fronts for locomotive under four yaw damper layouts.**

# Parameter analysis

## Global sensitivity analysis based on RBF-HDMR model

Straight track with low conicity condition

$W_{yf}$  and  $W_{yr}$ --lateral ride comfort indexes of the carbody's front and rear



Curved track with normal conicity condition

$\Gamma_{WF}$  and  $\Gamma_{DC}$ --wheelset force and derailment coefficient

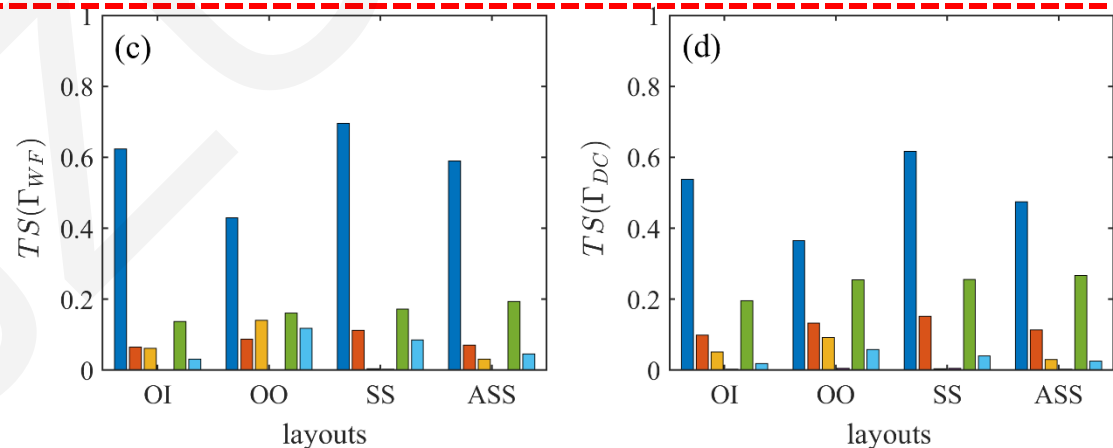


Fig. 4. Global sensitivity analysis results.

# Discussion

## ■ hunting modal analysis

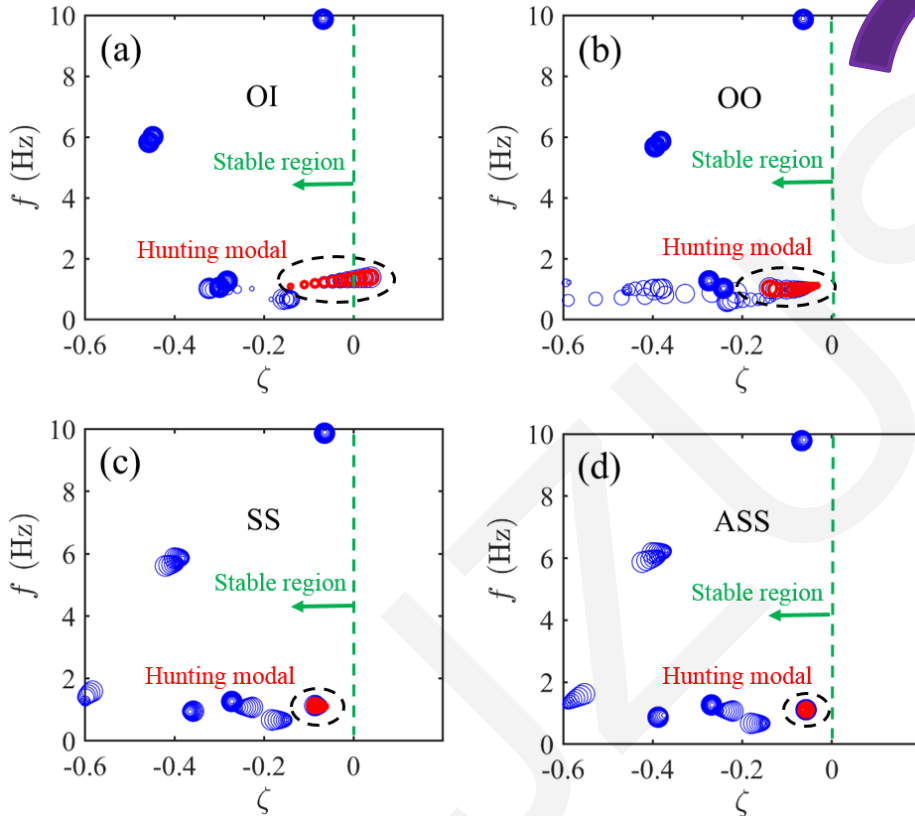


Fig. 5. Root locus curves with the variation of  $A_{CSX}$

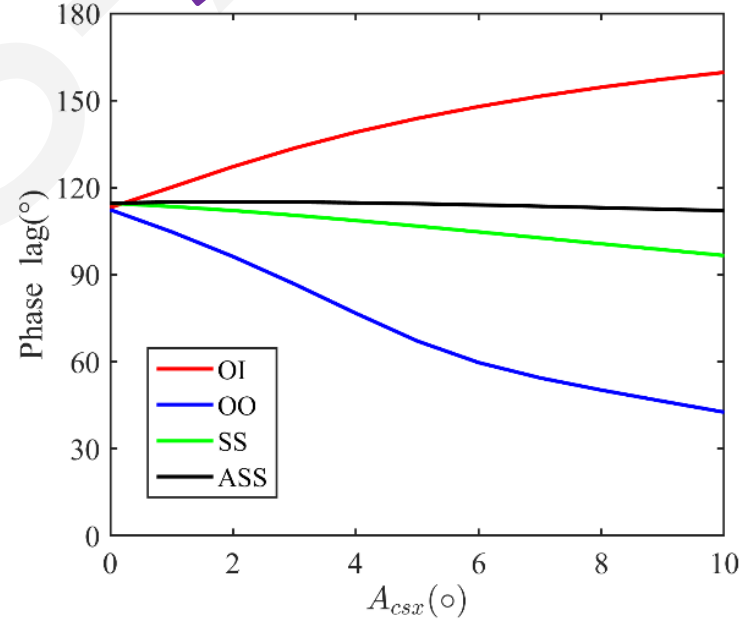
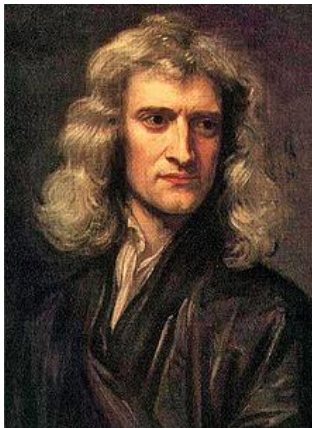


Fig. 6. between the carbody's lateral and yaw motions.

# Conclusions

- The yaw damper layout has a significant impact on the lateral stability and ride comfort of locomotives, and there exists a certain selection principle between lateral installation angles and yaw damper layouts.
- Only when the locomotive adopts the yaw damper layout with opening outward, the difference in lateral ride comfort between the carbody's front and rear ends can be reduced by optimizing the lateral installation angle.



**I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me.**