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Numerical study on the flow field characteristics of the new high-speed maglev train in open air

Peng Zhou

Key words: Maglev train; High-speed; IDDES; Aerodynamic load; Vortex; Time-averaged slipstream

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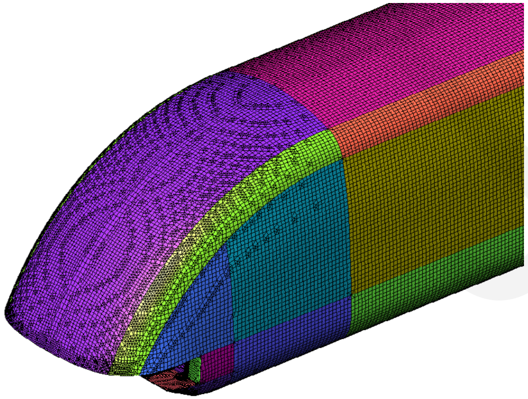
Southwest Jiaotong University, China

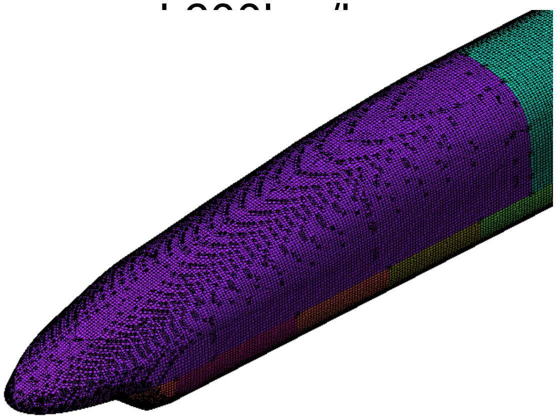
Pursue higher maglev train speed

Aerodynamic optimization

Shanghai maglev train
Maximum running speed:430km/h

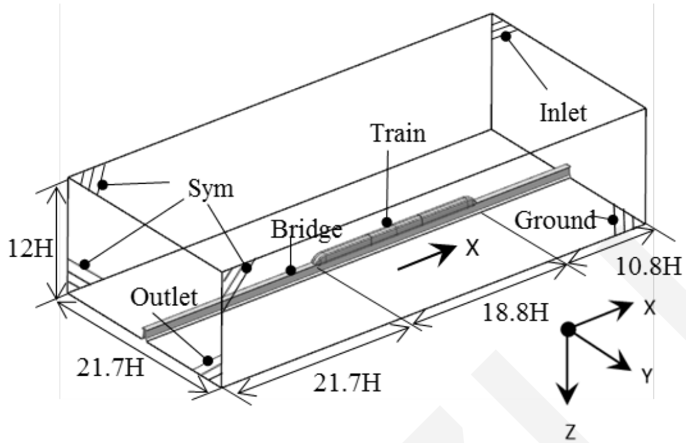
Future maglev train
Maximum running



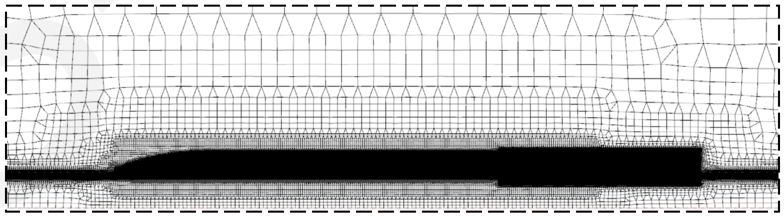


CFD procedures

Domain → Mesh → Solver



(a) Domain

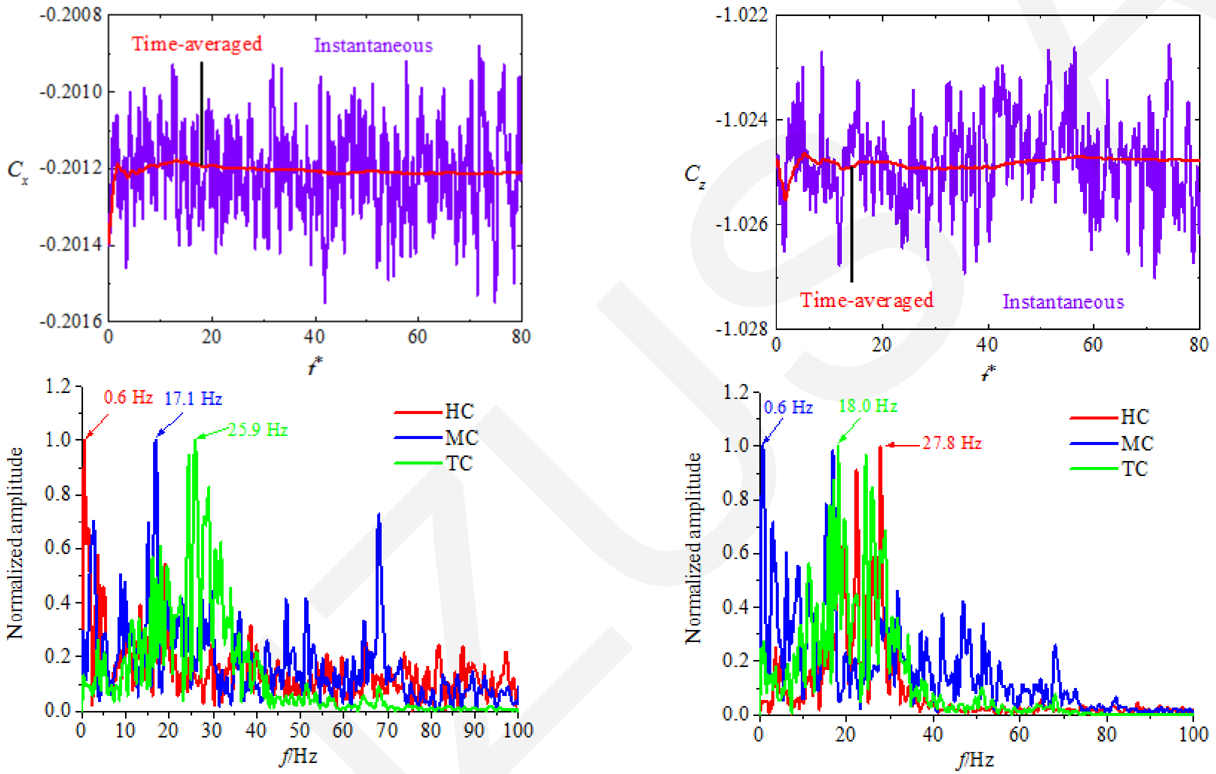


(b) Mesh

Solver	Density-based
Flux-difference splitting method	Roe
Spatial discretization scheme	Second order upwind
Time-stepping method	Implicit pseudo-time marching
Turbulence modelling	IDDES

Simulation results

■ Aerodynamic loads

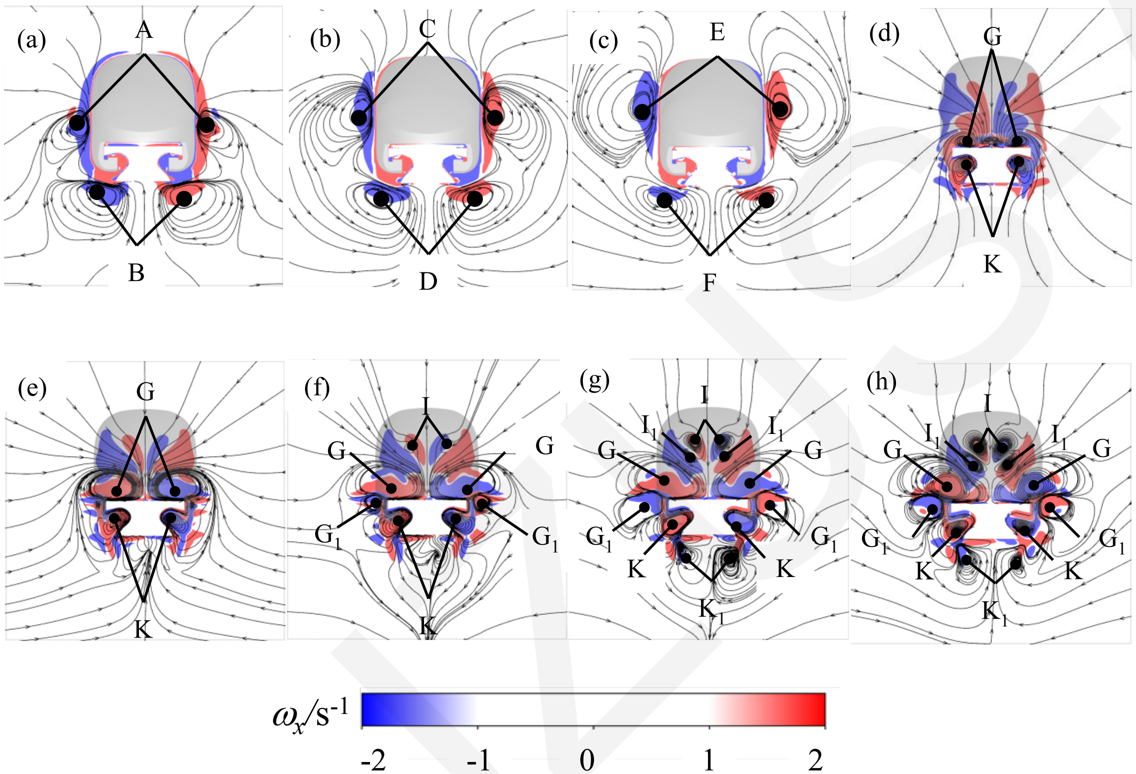


(a) Drag coefficient (b) Lift coefficient

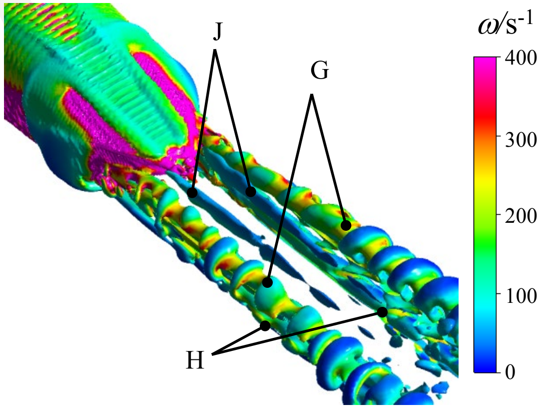
Time-domain and frequency-domain characteristics of loads

Simulation results

Wake vortex



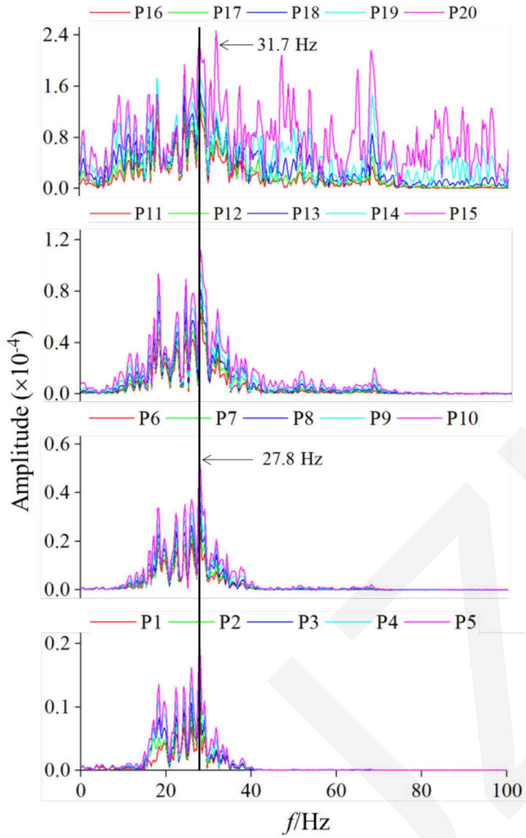
Wake vortex shape at different cross sections

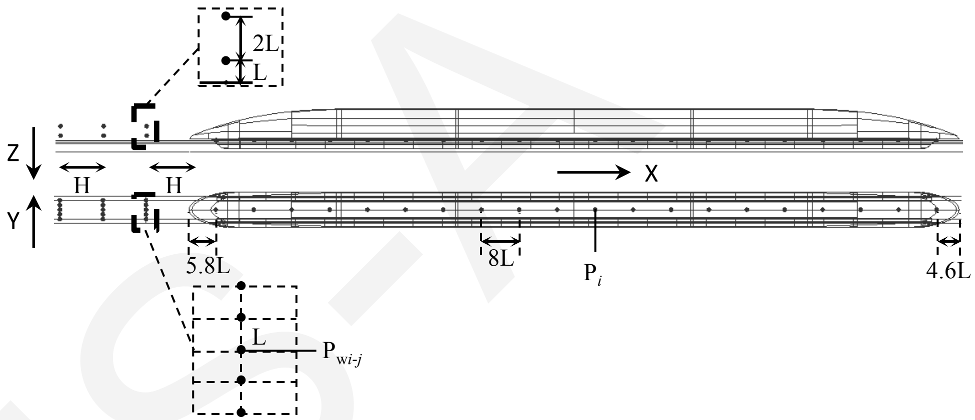


Vortex cores in wake

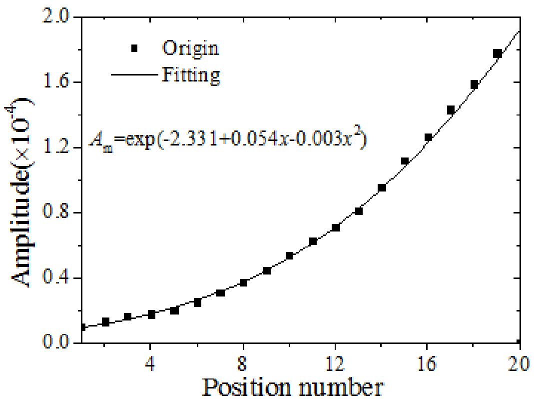
Simulation results

■ Gap vortex





Monitoring point position

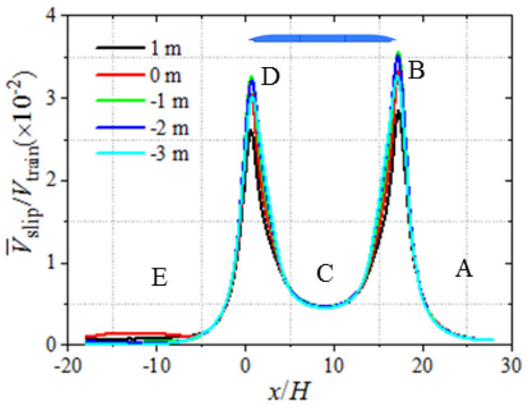


Variation of pressure coefficient amplitude to frequency for different monitoring positions in the gap

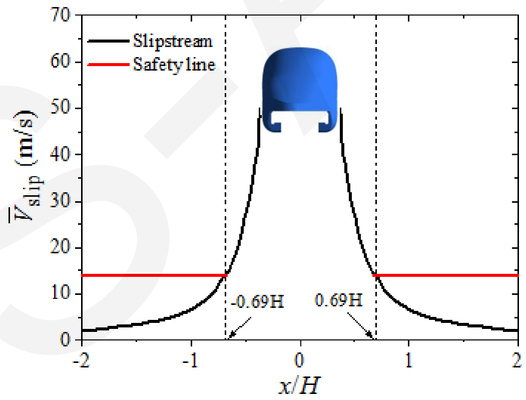
Change of the pressure coefficient amplitude with the monitoring point position

Simulation results

■ Slipstream



Typical time-averaged slipstream



Safety domain

Conclusions

- The new maglev has some good aerodynamic load performance

- Many high intensity vortices are distributed in the narrow space between skirt plates or train floor and track

- The large vortex shedding from the wall surface may break an obvious rule of wall boundary layer development in that its thickness gradually increases in the streamwise direction.

- The time-averaged slipstream development of the maglev train can be mainly divided into five typical processes.