Experimental analysis of the mechanism of high-order polygonal wear of wheels of a high-speed train

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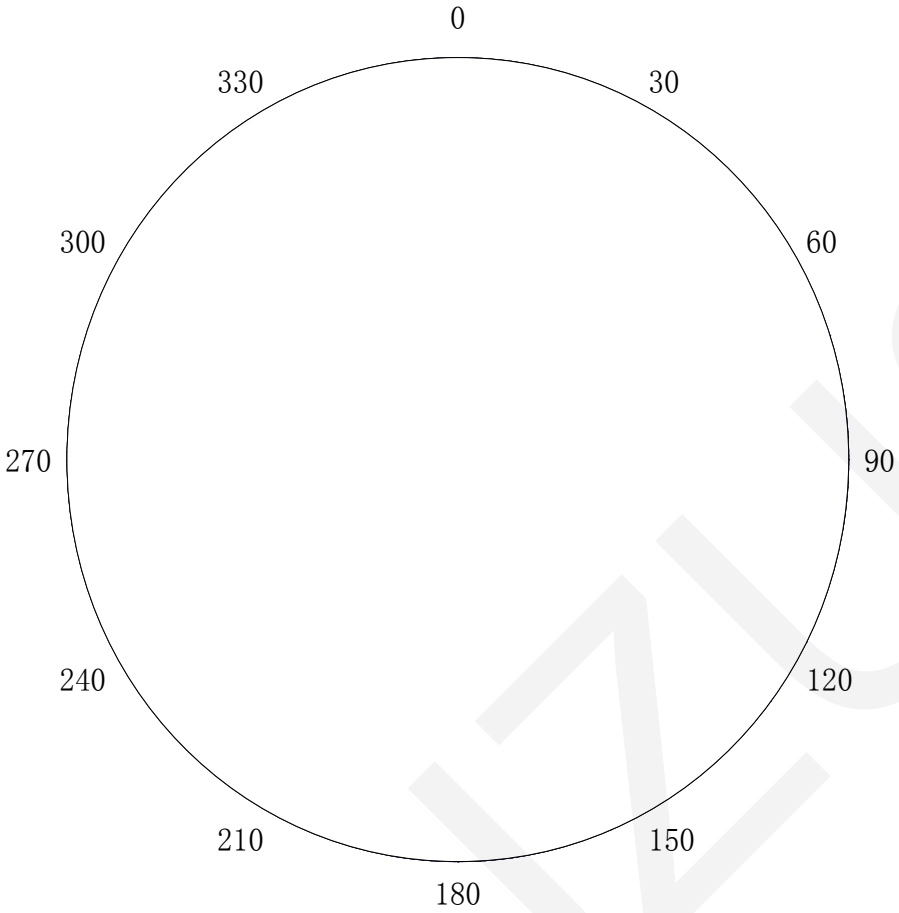
Polygonal wheel and its influence



Polygonal wheel

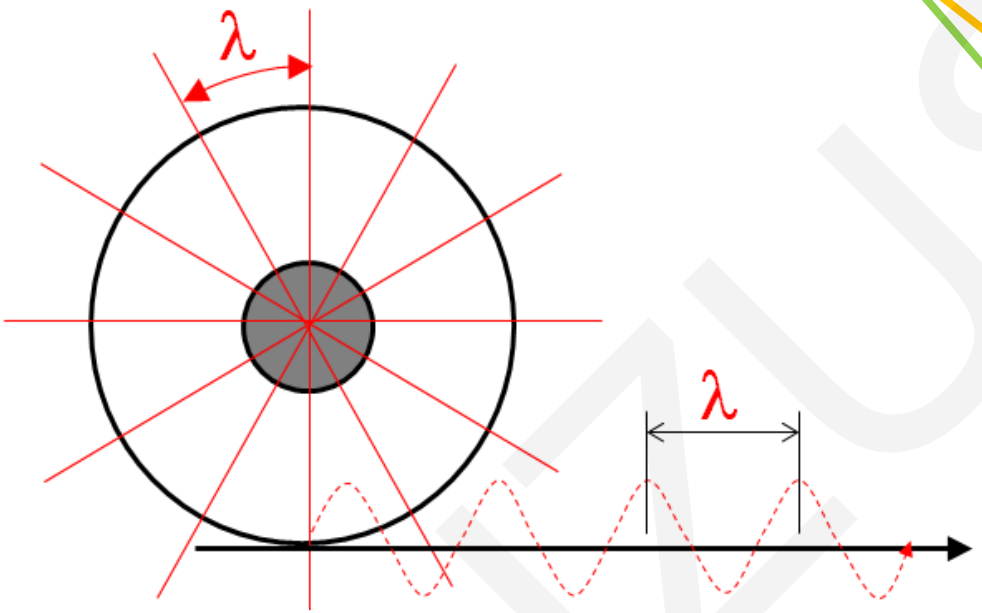
harmful effect



UZUSA

Mechanism

$$\frac{\text{Operating speed } v}{\text{Exciting frequence } f_0} = \text{wavelength } \lambda$$



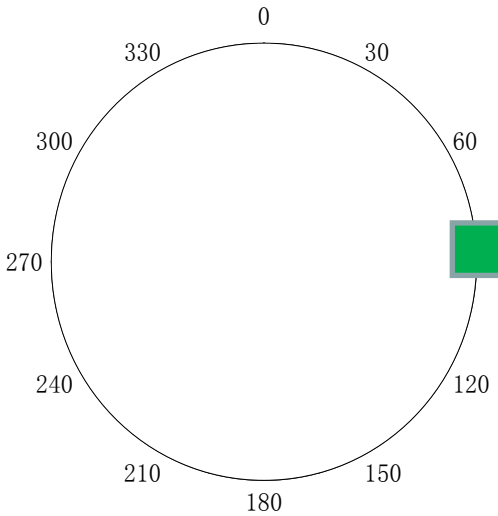
Rail ×

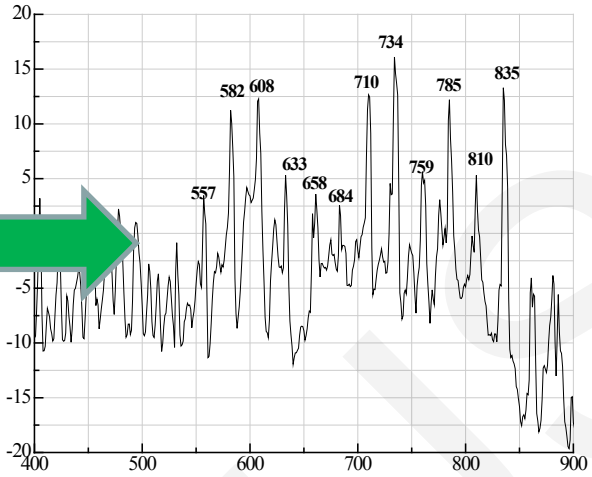
Vehicle √

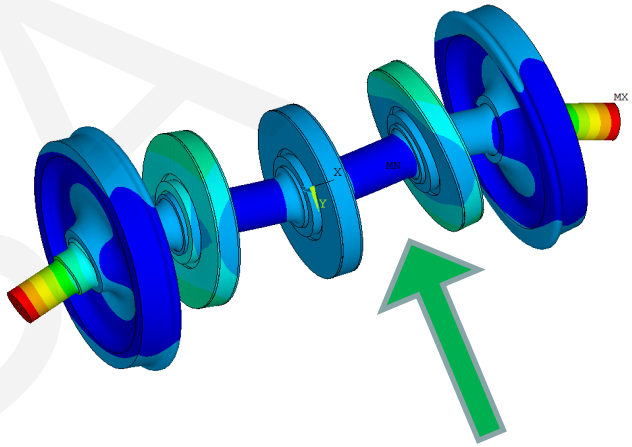
$$\text{Exciting frequence } f_0 = \frac{v}{\lambda} = \frac{v}{\pi D} \times (22\sim23) = \frac{\frac{250km}{h}}{\pi D} \times (22\sim23) = 566\sim591(\text{Hz})$$

JZUSA

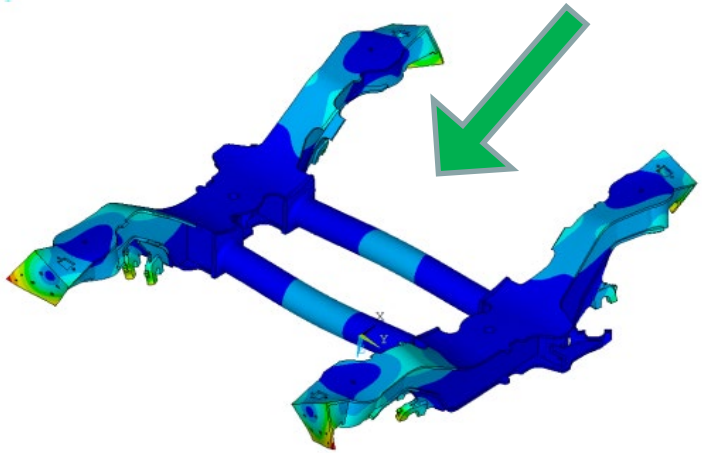
Mechanism

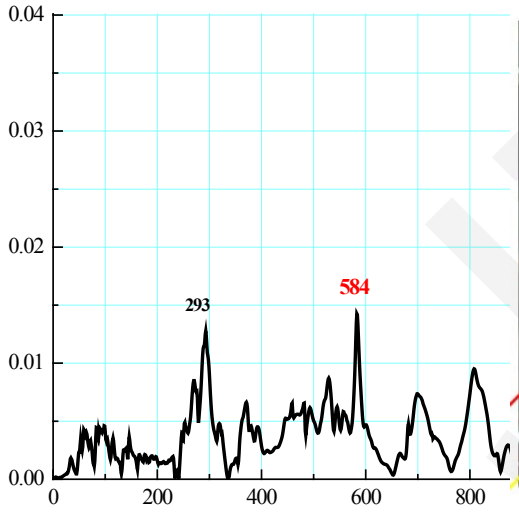


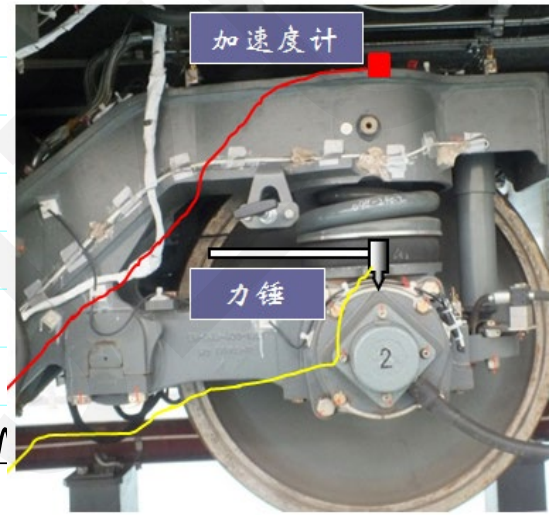




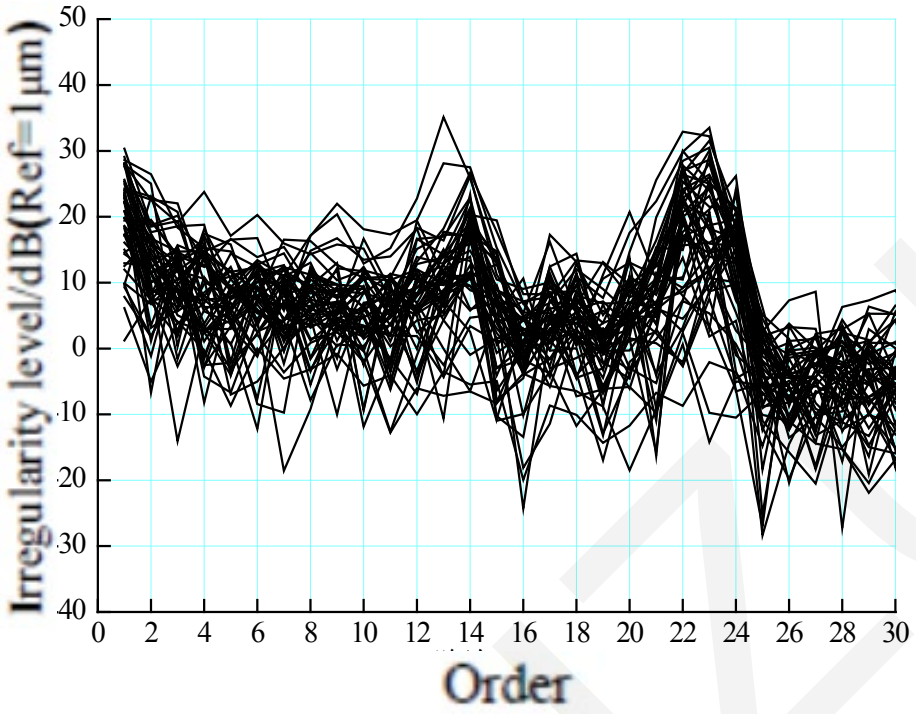
580Hz

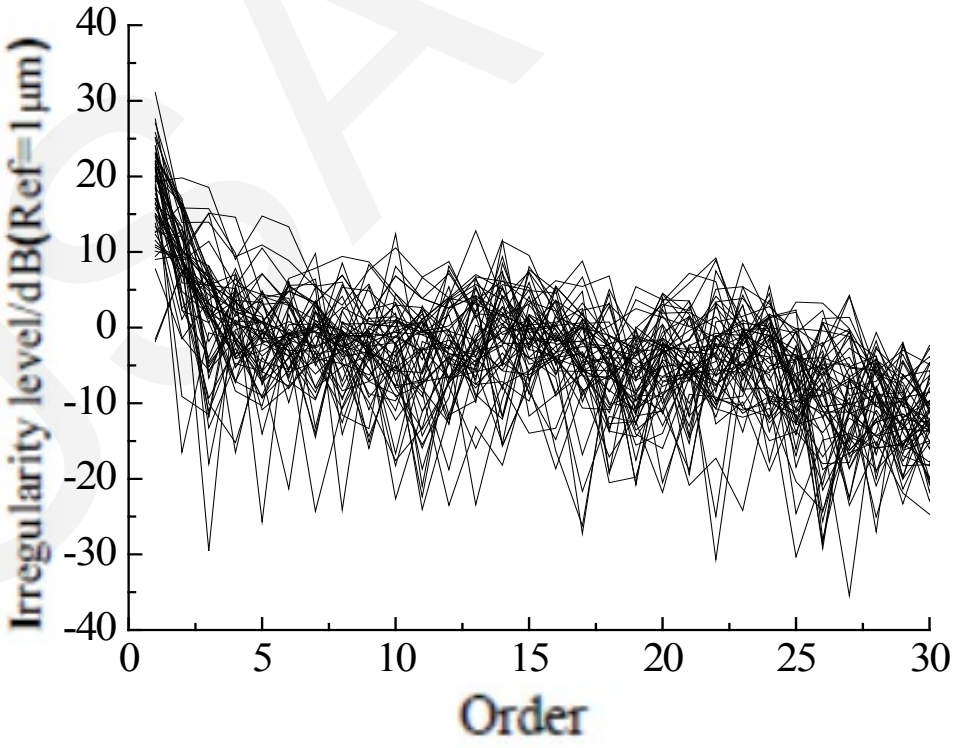






Solution





Constant speed operation

Variable speed operation

Conclusions

- 1. The mechanism of the polygonal wear of wheels of the high-speed train should be attributed to the excited resonance of the train/track coupling system in operation, and its root cause is the excited resonance of the bogie of the train in high-speed operation and under the extensive excitation of wheel/rail, such as rail welding, normal irregularities of the track, initial rail corrugation caused by initial grinding of new rails, initial defects caused by wheel processing (eccentricities of mass and roundness).
- 2. The basic condition for the polygon generation of wheels depends on the operation speed, the excited resonant frequency and the current perimeter or diameter of wheel. If the perimeter of wheel can be approximately divided by the wavelength corresponding to the excited resonant frequency of the bogie, the polygonal wear easily generates and develops quickly. The wavelength is obtained by dividing the operation speed with the frequency of the excited resonance.
- 3. Changing the operation speed can easily break the basic condition for the polygon generation of wheels and effectively suppress the growth of the polygonal wear. But it is not easy to change the resonant frequencies by changing the structure parameters of the bogie or the diameters of the wheels due to the decrease of the diameters with the mileage increase. Also the diameters of the wheels are strictly under control in operation and maintenance of trains.