講演番号	141

文献番号	20225141

Trochoidal Curve Representation of Tire Rolling Motion as The Basis of Tire Vibration Analysisthe

Masao Ishihama[1)]

1) Ishihama Giken Consulting
2-27-15 Shonan Takatori, Yokosuka 237-0066 Japan (E-mail: ishihama@alum.mit.edu)

KEY WORDS: **tire, road noise, exterior noise, CAE simulation [B3]**

A tire rolls as a pseudo cylinder with an effective radius smaller than its nominal radius. The phenomena such as collision and contact between the tire and the road surface caused by this geometric relationship were analyzed in this research. The main idea used was modeling the motion trajectory at one point on the tread surface as a trochoid curve. By this modeling, we obtained better understandings on the excitation to tire structure from road-tread contact. Then, a dynamical system model that can explain the vibration process at the tire-road contact patch trailing edge under heavy acceleration conditions. Further, the process of generating tread twisting vibration modes were modeled based on these findings.

The cause of the increase in tire radiation noise during intense acceleration was clarified by the following simple methods.

1) The motion trajectory of the tread was represented by a trochoid curve. (Fig.1)

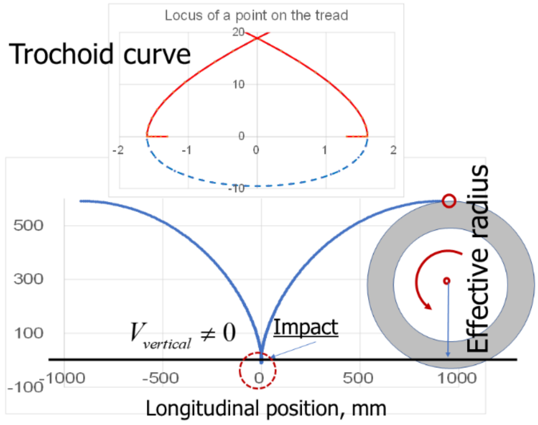

Fig. 1 Trochoidal trajectory of a point on the tread (one cycle in the lower graph) and its enlarged version around road contact timing. (upper graph)

2) Considering the sliding vibration of the tread based on the difference between this trochoid curve and the road surface.

3) The vibration waveforms during accelerated vehicle operation were measured by an accelerometer installed on the tread inner wall.

4) The collisions between the tread and the protrusion on the road surface were treated as a narrow band random signal based on the measured values. (Fig.2)

5) Theoretical estimation of the stress field of the sidewall that transmits the driving force from the wheel to the tread.

6) Building a dynamic model of vibration caused by the tread block being pulled by the driving force.(Fig.3)

7) The restoring force of this vibration was theoretically expressed by chordal vibration based on the tension of the steel belt.

8) Consideration of the process in which the non-uniformity of the excitation force acting on the tread from the road surface in the width direction evokes radial vibration of the tread.

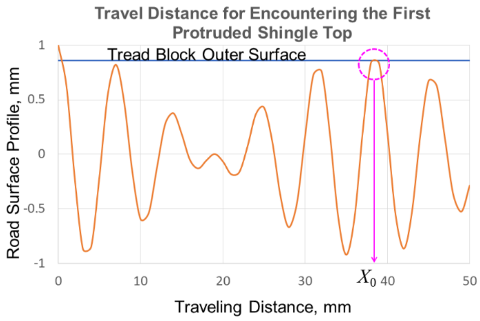

Fig.2 Expected tire traveling distance before encountering the first protruded shingle top.

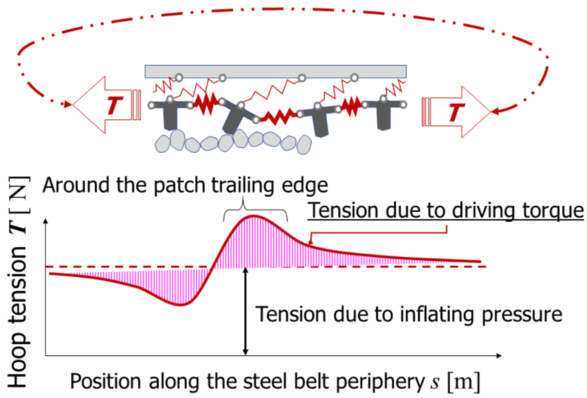

Fig.3 Lumped mass dynamical model of the steel belt with a sticked tread block.

The above methods are convenient tools to make a rough but quantitative prediction on the influences of such factors as tire radius, inflation pressure, driving force and road surface roughness to tire radiation noise with minimal computation resources.