Growth Mechanism and Evolution Process of Rail Corrugation Based on Theoretical and Numerical Analyses

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Rail corrugation, which causes the vibration and the noise, is a phenomenon in which roughness patterns of approximately regular wavelengths are formed on the rail surface by trains running. In this paper, the growth mechanism and the wavelength determination mechanism of the rail corrugation are analyzed theoretically from the viewpoint of track and vehicle dynamics using an elastically supported beam model, and the growth factors of the corrugation are identified as four anti-resonance phenomena. In addition to the theoretical analyses, using numerical simulation method, it is confirmed that there are formation, growth, and saturation stages in the evolution process of the rail corrugation. The evolution process is also verified by the measured rail corrugation of actual commercial lines.