Секция «Взгляд в будущее железнодорожной отрасли: инновации, развитие, новые продукты»

Smart Sleeper - an innovation for the railway future

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Railways have evolved since the first rolled rail came into existence (1789). They consist of superstructure (rails, fastening systems, rail-pads) and infrastructure (platform). In practice, the deterioration of the track can be shown through the wear of rail-pads and fastening systems, aging ballast and the defects in the rolling stock. However, it is difficult to obtain information on these elements in track. SATEBA proposed a Smart Sleeper [3], a complementary solution to monitor the state of the track immediately. This is an integrated sleeper of strain sensors (Fiber Bragg gratings), making it possible to obtain information on the behavior of the railway track sleepers in general and on its level of deformation while the train passes the sleeper in particular (see Figure 1).

This work serves as part of the joint research collaboration between SATEBA and the École des Ponts ParisTech (ENPC), which investigates the mechanical behavior of railway sleepers and the deterioration of railway tracks and rolling stocks.

The first part of this work presents the existing models of a ballasted and non-ballasted railway track and proposes a dynamic model of the rail-track sleepers. By using the relationship between the reaction force applied to the sleeper and the rail displacement in the frequency domain, and thanks to the Green's function, the dynamic models of the railway sleepers enable calculating quickly the response of sleepers with a result close to the authentic signal recorded in an instrumented site [1]. A simulation of a sleeper by using the finite elements has been validated by a comparison with the experimental results.

The second part of this work focuses on the identification of the parameters of the rolling stock and the railway track [2]. The determination was carried out by a parametric study with different kinds of foundation. The determination of these indicators allows us to bounce the state of the track. Also, thanks to dynamic models of the railway track sleeper, the method of identifying the train loads has been developed. An industrial application - a software namely **"ChargeTEBA"** has been developed to facilitate the processing of signals recorded on the instrumented site (see Figure 2). A new version of an instrumented sleeper is proposed to obtain better signals, state of track and also rolling stock information.

This work creates a new approach for maintenance a railway track in the industry 4.0. By analyzing the database of measurements in a long period, we can estimate the moment to renew the track. All of rolling stock which passed on the instrumented site are diagnosed to be sure the security of the passing train. Moreover, the Smart Sleeper can be implemented at the transition zone or a weak foundation to study the stability of the track.

References

1) Tran L-H. et al., A Fast Analytic Method to Calculate the Dynamic Response of Railways Sleepers, Journal of Vibration and Acoustics 141 (1) (2019). doi:10.1115/1.4040392
2) Tran L-H. et al., Analytical method to identify train load from integrated sleeper in-situ, 13th World Congress on Computational Mechanics (WCCM XIII), July 2018, New York, USA

3) Smart Sleeper, solution connectée : https://www.sateba.com/nos-solutions/solution-connectee/

Illustrations

Рис. 1. Smart Sleeper (photo source : Sateba.com)

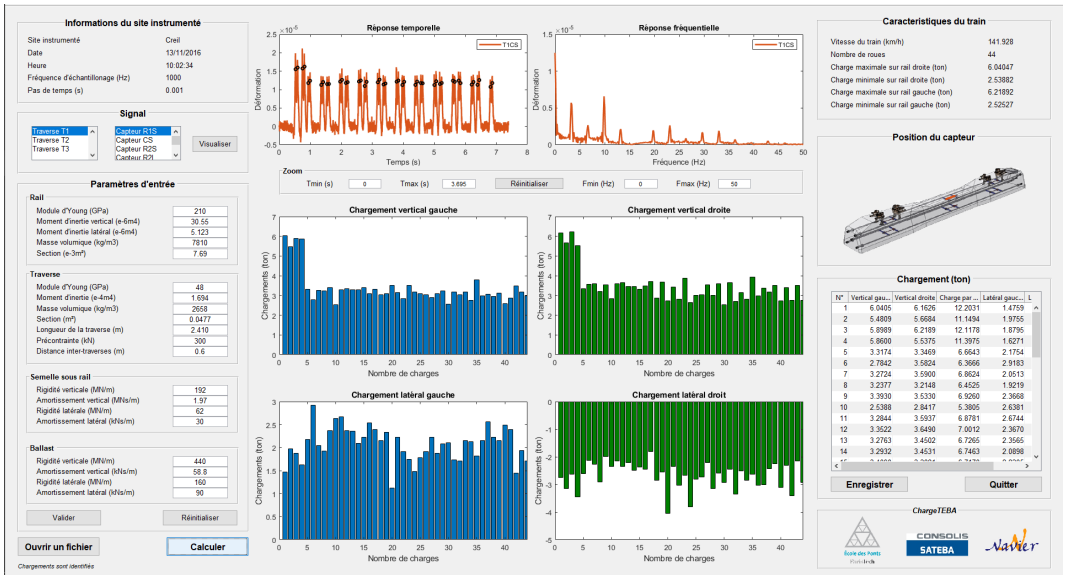

Рис. 2. Inteface of ChargeTEBA software (french version)