NUMERICAL INVESTIGATION OF THE INTERACTION OF AN ULTRASONIC WAVE WITH A DISCOUNTINUOUS CONTACT INTERFACE

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KEYWORDS
Numerical modelling; wave propagation; ultrasound; rough contacts; contact stiffness

ABSTRACT
When two surfaces are brought into contact and slide against each other, junctions are formed at the interface. The dynamics of formation rupture and evolution of these junctions governs the tribological response of the macro-contact. Getting insight on the real-time behaviour of these junctions is a challenging task.

Ultrasonic wave propagation is a phenomenon that has been already widely used in non-destructive techniques or medical imaging. When an acoustic wave reaches some interface or other, it can be partially transmitted or partially reflected depending on the nature of this interface and the properties of the bodies in contact. An application in tribology appears promising as this technique may be used to investigate, in-situ and in real-time, the interaction between the surfaces in contact [1-3].

This work addresses the understanding of the wave propagation, reflection and transmission through the interface by means of a numerical model. Pulse echo method of a 9MHz ultrasonic pulse is followed on two aluminum bodies to record the transmitted through and reflected back signals from the contact interface. Reflection and transmission were both analyzed as a function of local interface parameters such as number, shape of asperities in contact, contact ratio etc.(Fig. 1).

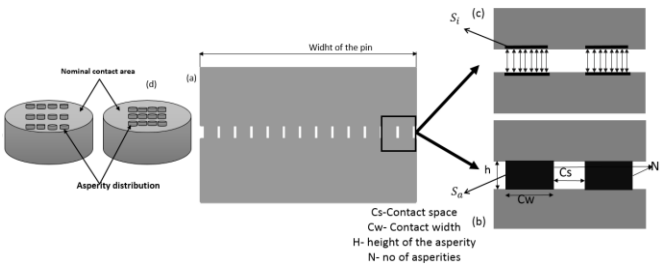

Fig.1 Asperity distribution with interfacial and asperity stiffness representation

Transmission coefficient is for example investigated depending on the contact ratio and number of asperities in contact as shown in Fig. 2. Results from the simulations are first compared to the extensive work performed by Kendall and Tabor [4] and connected to the stiffness relation in multiple contacts. Assumptions made by the authors are especially discussed. The numerical model is then used to investigate the interaction between the ultrasonic wave and the contact interface at the asperity scale. Interesting local diffraction phenomena are especially highlighted.

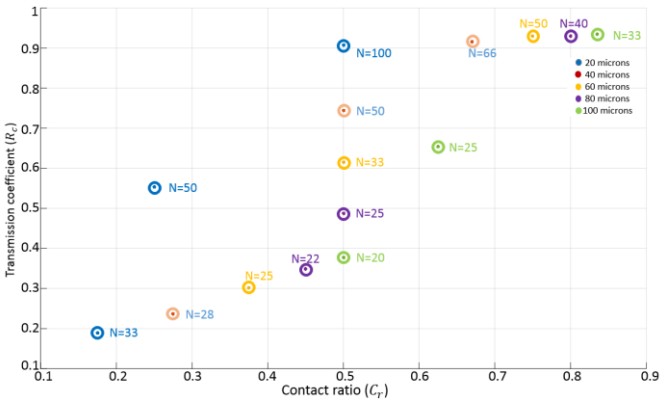

Fig.2 Evolution of the transmission coefficient (Rc) depending on the contact ratio (Cr)

ACKNOWLEDGMENTS
This work was supported by the LABEX MANUTECH-SISE (ANR-10-LABX-0075) of Université de Lyon, within the program "Investissements d'Avenir" (ANR-11-IDEX-0007) operated by the French National Research Agency (ANR).

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