

## **Ultrasonic assessment of imperfect contact interfaces using convolutional neural network**

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### **ABSTRACT**

Interfaces play an important role in determining the structural performance of modern materials. This study is motivated by non-destructive evaluation (NDE) of rough interfaces between bone and implant based on reflection of ultrasound. In this model a fluid domain mimicking the soft-tissue may be present between the bone and the implant. In this work, we developed a method to assess the soft tissue thickness at the BII based on the analysis of its ultrasonic response using a simulation based-convolution neural network (CNN). A large-annotated dataset was constructed using a two-dimensional finite element model adapted for analyzing the reflection of plane waves. The proposed network was trained by the synthesized ultrasound responses in the time-domain and was validated by a separate dataset from the training process. The linear correlation between actual and estimated soft tissue thickness shows very good  $R^2$  values equal to 99.52% and 99.65% and a narrow limit of agreement corresponding to  $[-2.56, 4.32 \mu\text{m}]$  and  $[-15.75, 30.35 \mu\text{m}]$  of microscopic and macroscopic roughness, respectively.

### **REFERENCES**

Kwak, Y., Nguyen, V.-H., Hériveaux, Y., Belanger, P., Park, J., & Haiat, G. (2021). Ultrasonic assessment of osseointegration phenomena at the bone-implant interface using convolutional neural network. *The Journal of the Acoustical Society of America*, 149(6), 4337–4347. <https://doi.org/10.1121/10.0005272>