QUANTITATIVE ACOUSTIC COUPLING EVALUATION IN US-GUIDED FOCUSED ULTRASOUND SURGERY

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OBJECTIVE

A correct acoustic coupling between the therapeutic transducer and the patient's body is crucial for efficient and safe Ultrasound-guided Focused Ultrasound (USgFUS) treatments. Unfortunately, nowadays clinicians verify the coupling by only qualitatively inspecting Ultrasound images. This study introduces a quantitative metrics for evaluating the quality and correctness of the acoustic coupling in a pre-operative phase.

METHODS

Different acoustic coupling conditions were replicated using the position control of a robotic USgFUS platform (www.futuraproject.eu). The coupling system consisted in a 150µm latex membrane attached to the FUS transducer and filled with deionized and degassed water. An Agar-based phantom was used as skin simulator (Fig.1a). For each coupling condition, *i.e.* robot position (*z*), a safe low-energy FUS sonication (1W power, 1s duration, 1.2MHz frequency) was executed and the related RF echoes were recorded through the 2D confocal imaging probe. The introduced Acoustic Coupling (*AC*) coefficient is calculated from the frequency peak (P_z) - at the working frequency of the FUS transducer - of the reflected RF signals.

RESULTS

Fig.1b shows a sigmoidal trend between *AC* coefficient and robot position (bigger the value of the robot position (*z*), better the acoustic coupling) until reaching a plateau, where the *AC* samples are statistically equivalent.

CONCLUSIONS

The introduced *AC* coefficient paves the way to preoperatively quantify the quality and correctness of the acoustic coupling in a USgFUS clinical set-up, thus ensuring the safety and efficacy of the FUS treatment.

ACKNOWLEDGEMENTS

Research supported by FUTURA2020 project (grant agreement 801451) and River Global Capital Ltd.

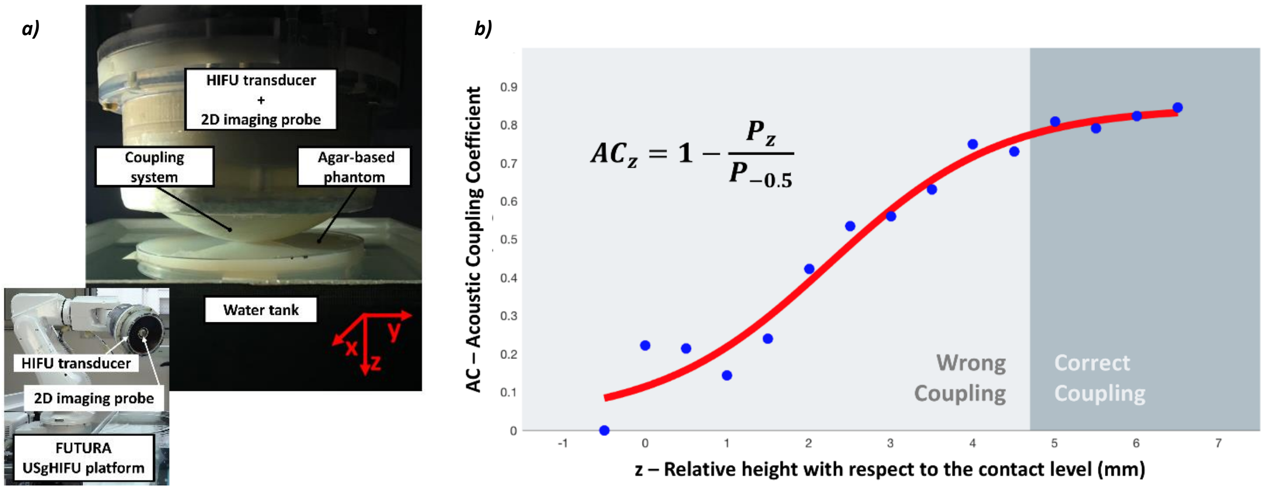

Figure 1: a) USgFUS platform components (bottom left) and experimental set-up (centre): to simulate different coupling conditions, the coupling system was moved along the z-axis towards the phantom. b) AC coefficient (defined in the upper left) as a function of the robot position, normalized with respect to a non-contact condition (z=-0.5 mm).