

**MRI-guided Focused
Ultrasound robotic
system for brain tumors.**



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NEWSLETTER

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Development of 4-DOF Robotic system
MRI compatibility assessment



German
Medical
Institute

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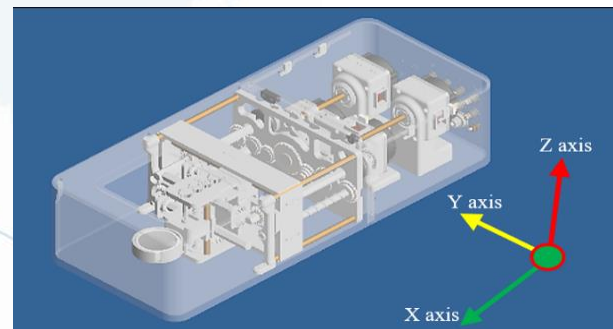


Cyprus
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Technology

DEVELOPMENT OF 4-DOF ROBOTIC SYSTEM

The robotic device was designed on Microstation software. The various parts were manufactured on a 3D printer (FDM400, STRATASYS, USA) using Acrylonitrile Styrene Acrylate (ASA) material.

All mechanisms were arranged inside the water container, except for the ultrasonic motors, which operate in a separate enclosure.



CAD drawing of device's interior.

The positioning mechanism enables motion of a single-element FUS transducer operating at a frequency of about 1 MHz along four axes: forward/backward (X), left/right (Y), upward/downward (Z) and rotational.



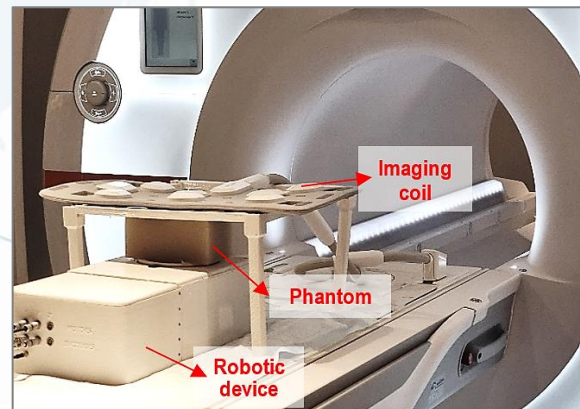
Photo of manufactured device.

The four stages are driven by piezoelectric ultrasonic motors (Shinsei Kogyo Corp., Japan), further incorporating optical rotary encoders (US Digital Corporation, USA) to ensure accurate movement.

The robotic device has compact dimensions, making it suitable for integration with any conventional high-field MRI scanner, laterally to a patient lying in supine position.

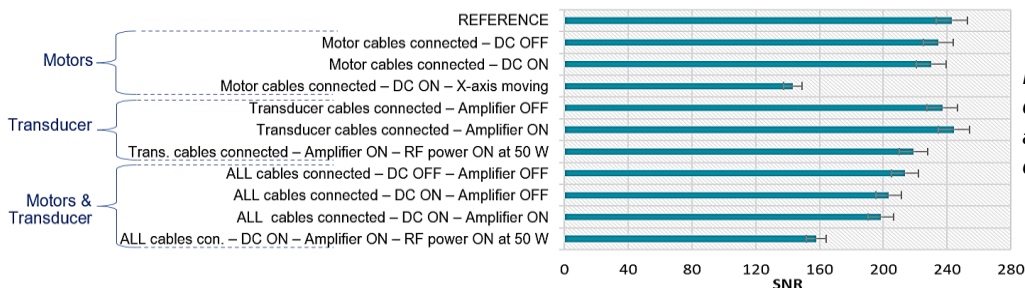
MRI COMPATIBILITY ASSESSMENT

This task was performed in a 3T MRI owned by LINAC. The Signal to noise ratio (SNR) served as the main metric for assessing MRI compatibility. The device was positioned on the patient couch and an agar-based phantom was placed on its acoustic opening. The phantom was scanned using Spoiled Gradient Echo (SPGR) and T2-W Turbo Spin Echo (TSE) sequences. A series of 2D coronal and axial images were acquired under different activation states of the electronic system and amplifier.



Experimental set-up in 3T MRI scanner.

The BRAINSONIC system operated seamlessly within the MRI scanner, experiencing no malfunctions or operational issues. Sufficient SNR for high quality imaging was achieved for both employed sequences and maintained among different activations of the robotic system.



Bar chart of SNR values calculated for the different activation conditions (from coronal SPGR images).