

# MR-HIFU ACOUSTIC COUPLING DEVICE TO IMPROVE PERFORMANCE AND REDUCE SIDE EFFECTS

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## Technology Description

Engineers in Prof. Hong Chen's laboratory have developed a multifunctional, MR-compatible device designed to improve the performance of Magnetic Resonance High Intensity Focused Ultrasound (MR-HIFU) by increasing the efficiency of the ultrasound transmission, cooling the patient's skin and preventing accidental movement. This invention provides three major functions that are critical to successful MR-HIFU treatment. First, the device has a multi-membrane system to form an impedance-matched acoustic coupling of the MR-HIFU system to the targeted region on the patient. This improves the efficiency of the ultrasound energy while adding a heat exchange system to regulate the temperature of the patient's skin. This helps avoid the most common side effect of MR-HIFU, burned skin. Finally, the device aims to improve accuracy by immobilizing the patient to prevent accidental movement which can misalign the treatment area.

HIFU and focused ultrasound (FUS) offer non-invasive treatment of deep tissues with minimal effect on overlying organs and tissues. MR guidance enables: targeting of HIFU to a relatively precise region within the deep tissues; and thermal monitoring of the deep tissues using MR thermal measurement methods. Current applications for MR-HIFU include thermal ablation of benign growths (e.g., fibroids) and cancerous lesions (liver, brain, breast, prostate and lung). This acoustic coupling device could improve these current applications as well as expand the therapeutic potential of MR-HIFU.

## Stage of Research

The inventors have built a **prototype** of the coupling device, tested it with their MR-HIFU system and demonstrated its performance for coupling and cooling. They continue to improve the device for immobilization.

## Applications

- **MR-HIFU (Magnetic Resonance High Intensity Focused Ultrasound)** – particularly for treatment targeted to extremities such as head and neck and shoulders

## Key Advantages

- **Efficient ultrasound transmission** – acoustic coupling enhances the efficiency of HIFU energy to the treatment site
- **Improves accuracy** – immobilizes patient to prevent movement (which can cause misalignment of HIFU treatment and errors in MR temperature monitoring)
- **Prevents burns** – device cools the patient's skin by circulating cooled water at the HIFU target region, thus avoiding skin burns (the most common side effect of HIFU treatment)

- **MR compatible**

## **Patents**

- [Device for acoustic coupling, temperature regulation, and immobilization of patient during focused ultrasound therapy](#) (U.S. Patent Application Publication No. US20180318611)

## **Website**

- [Chen Ultrasound Laboratory](#)