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## MR-guided high intensity focused ultrasound (MR-HIFU)



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# PHILIPS

# MR-guided high intensity focused ultrasound (MR-HIFU)

An alternative form of non-invasive out-patient treatment in oncology



Professor Chrit Moonen

MR-guided high intensity focused ultrasound (MR-HIFU) is an emerging therapy technique using focused ultrasound to heat and coagulate tissue deep within the body, without damaging intervening tissue. Philips Healthcare is collaborating with Professor Chrit Moonen at the University of Bordeaux in the development of a dedicated MRI-guided HIFU system.

## The HIFU concept

In high intensity focused ultrasound (HIFU), a specially designed transducer is used to focus a beam of ultrasound energy into a small volume at specific target locations within the body. The focused beam causes localized high temperatures (55 to 90°C) in a region as small as 1 x 1 x 5 mm. The high temperature, maintained for a few seconds, produces a well-defined region of necrosis. This procedure is referred to as ultrasound ablation. The tight focusing properties of the transducer limit the ablation to the target location.

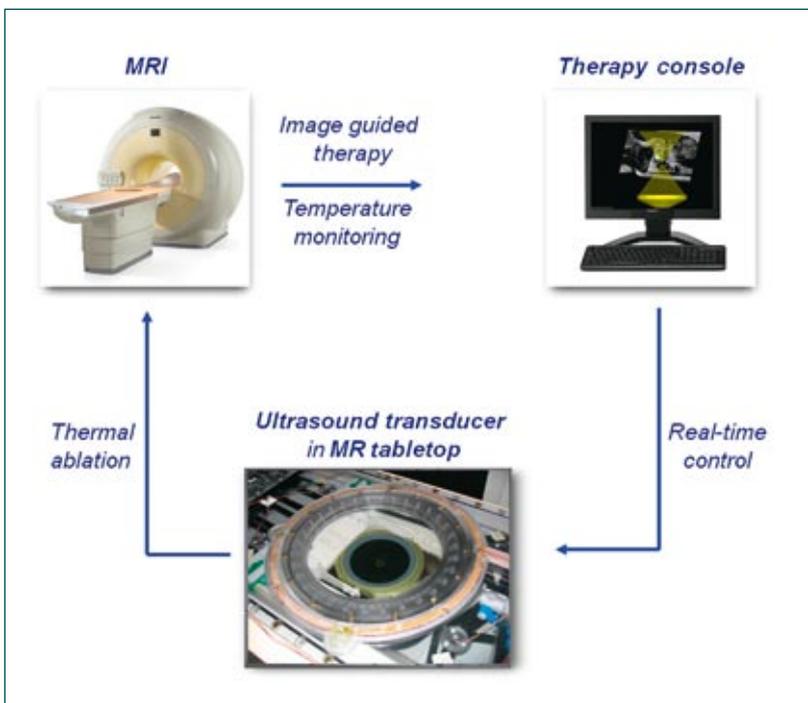
In many applications, the HIFU therapy is guided using diagnostic ultrasound. However, ultrasound imaging does not provide the high resolution images, real-time temperature monitoring, and adequate post-treatment lesion assessment required for fast and effective therapy.

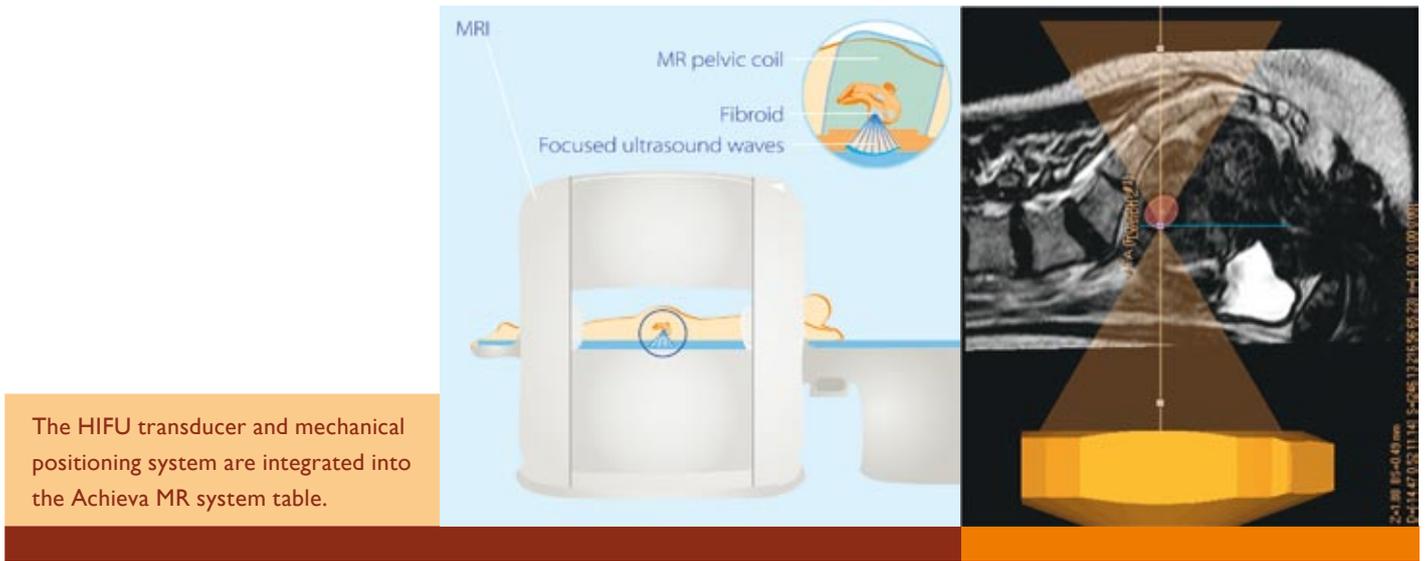
In contrast to ultrasound, MR imaging offers excellent soft tissue contrast, 3D imaging capabilities, and non-invasive temperature measurement techniques.

## Philips investigational MR-HIFU system

The Philips MR-HIFU system, under clinical investigation, is designed to address some of the problems encountered with currently available HIFU systems.

## MR-HIFU components





The Philips investigational MR-HIFU system uses the Achieva 1.5T or 3.0T MR platform, and comprises the following interconnected subsystems:

- Achieva MR system to monitor the procedure and provide real-time images.
- MR-HIFU patient tabletop with integrated MR-compatible high power phased array transducer with mechanical and electronic positioning.
- MR-HIFU therapy console to plan treatment, calculate real-time temperature maps, and control HIFU delivery.
- HIFU electronics for ultrasound power (energy) delivery and beam positioning.

The separate HIFU therapy console is used for treatment planning and control of the procedure. The intuitive and easy to learn graphical user interface offers multiple tools for safe procedure planning, based on freshly acquired 3D MR images.

During treatment, the therapy console calculates and displays real-time MR temperature maps in multiple planes or 3D, and implements a temperature feedback loop for energy control.

The real-time temperature imaging can be used to provide feedback to the HIFU system to control the amount of energy delivered to the tissue.

Parts of the procedure that require repetition of the same step are automated, but allow for user interruption/interaction.

### Volumetric HIFU

Normally, HIFU ablation is done using point-by-point ablation, which is time-consuming and can leave gaps between the treated points. Philips' investigational MR-HIFU system enables volumetric heating of a much larger area.

Theoretical models and animal studies indicate that the volumetric heating approach offers more effective treatment and has the potential to reduce the treatment time by a factor of 3 to 4.6.

### Uterine fibroids

HIFU is currently marketed in the United States for the treatment of uterine fibroids. Fibroids are non-malignant growths, which are estimated to affect four out of seven women in the United States, between the ages of 30 years and the onset of menopause. Approximately 10% to 20% of women with fibroids have symptoms severe enough to need treatment. The primary symptoms are pain and hemorrhage. In some 300,000 cases, hysterectomy is performed.

HIFU offers an alternative in the form of non-invasive outpatient treatment with minimal to no sedation.