Acoustic radiation force to generate magnetic sensing signal

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Introduction

Detection of mobile magnetic nanoparticles with an external sensing device demonstrates encouraging outcomes for both therapy and diagnostic applications.

Challenges of using permanet and alternative magnetic field are:

- Limited detection depth
- High energy consumption
- Expensive set up
- Eddy current and patient safety limitation

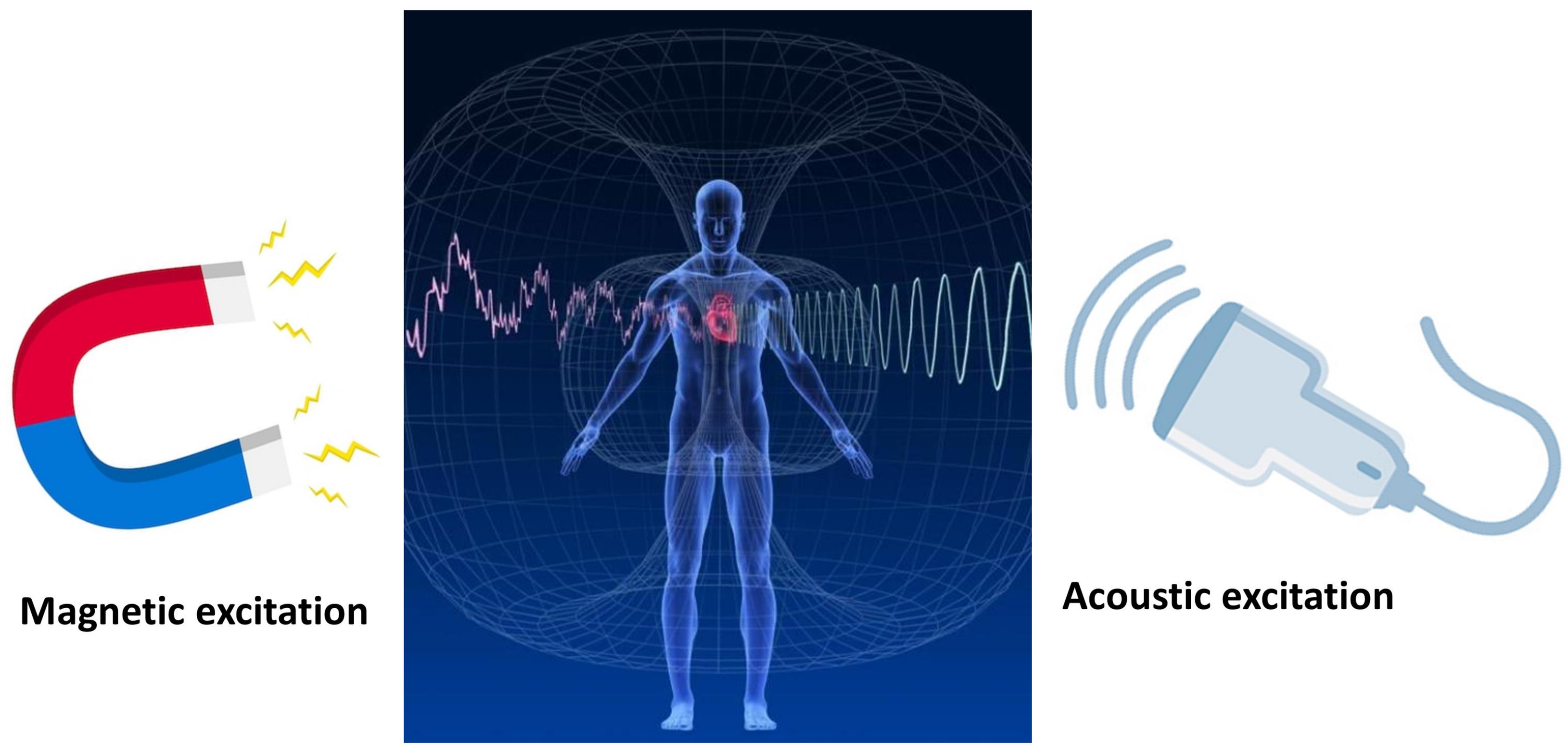

Figure 1. Excitation of MNPs in human body with magnetic field and acoustic radiation signal

Material

In this study we used acoustic radiation force as in combination of pulsed DC magnetic field to excite the MNPs.

Experimental setup consist of:

- DC magnetic field generator coil (strength?)
- Piezoelectric ultrasound transducer
- 10W RF amplifier
- Laparoscopy detection probe

Tracer

- Synomag® D-70 , nano-flower shaped MNPs

Method

- DC offset-field at a frequency of 5 kHz. Each cycle of the sequence consists of four blocks: no offset, positive offset, no offset, and negative offset.
- An acoustic square wave at a driving frequency of 100 kHz.

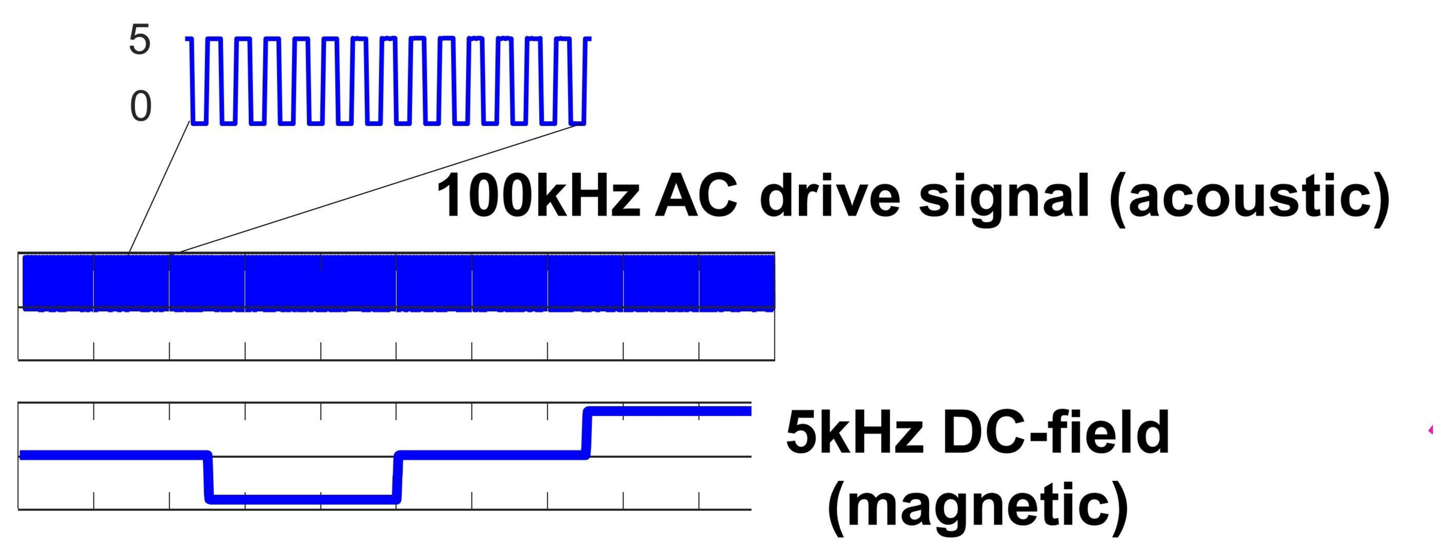

Figure 2. Acoustic AC and pulsed DC magnetic applied excitation

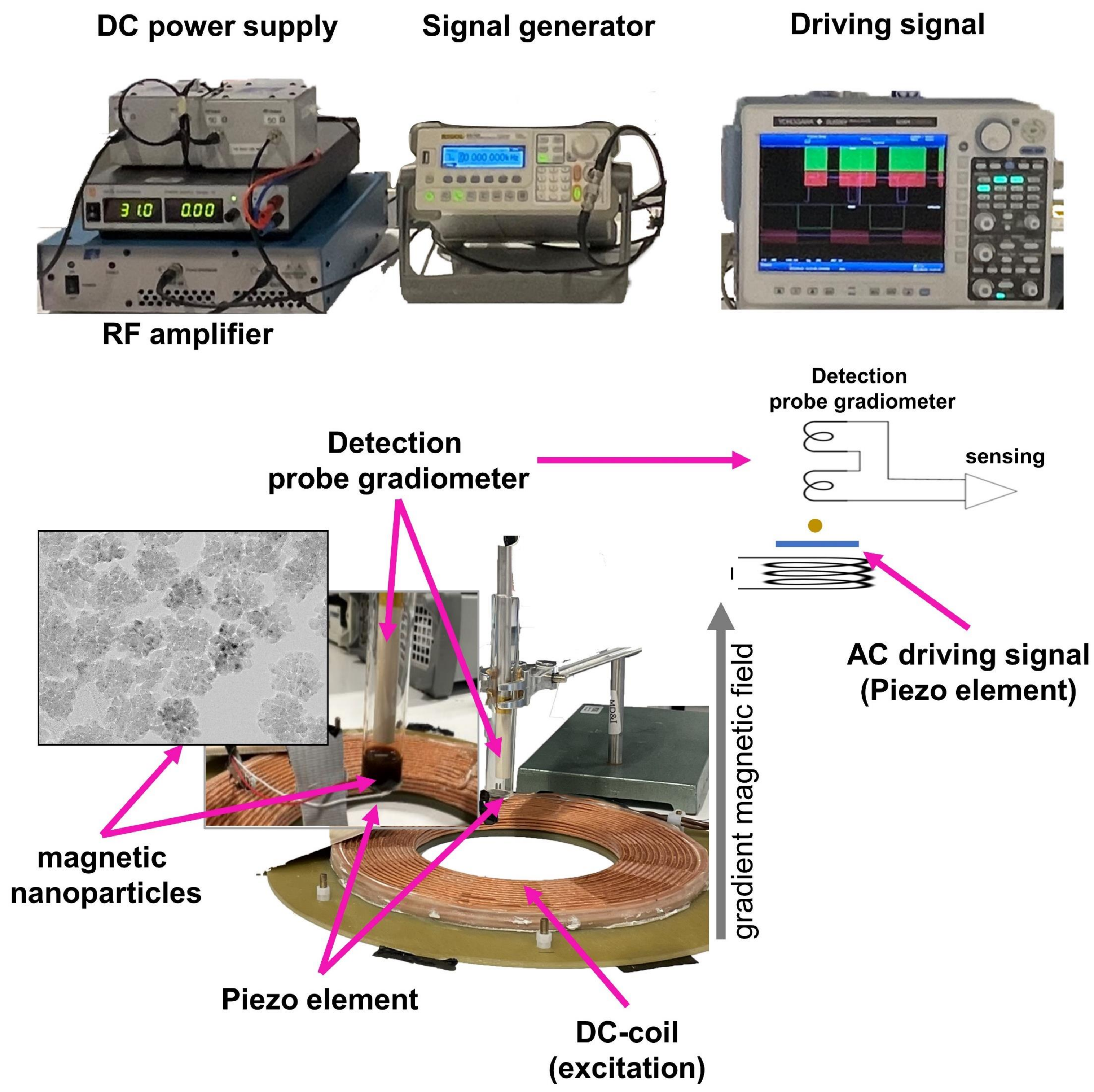

Figure 3. Experimental set up

Results

DC offset field is off: A minor variation in the detection probe voltage is observed when comparing the glass vial with a sample to an empty vial.

DC offset field is on: A significant distinction in detection probe voltage is observed when comparing the glass vial with a sample to an empty vial.

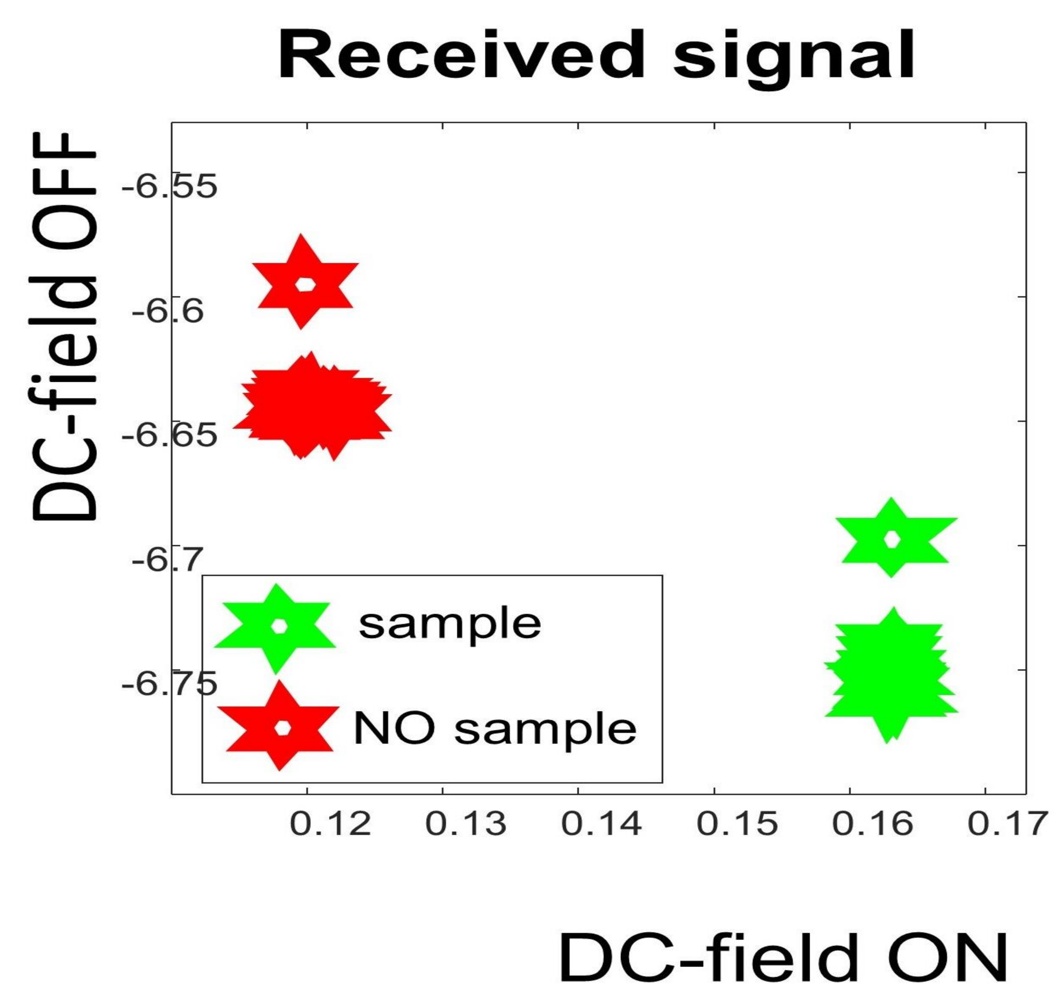

Figure 4. Results of experiment for both with and without MNPs sample

Discussion and future studies

- Acoustic radaition signal has capability to excite MNPs and detect their response through magnetic probe.
- For future research, it is advisable to employ a more realistic phantom, varying both DC and AC excitation pulses at different distances from the phantom.

References

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2. Waanders, S., et al., A handheld SPIO-based sentinel lymph node mapping device using differential magnetometry. doi: 10.1088/0031-9155/61/22/8120.

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