Course project titles

1. In vivo sonoporation by ultrasound (Cavitation, 500kHz), pair 1
2. Ultrasonic histotripsy of tumor tissue (Cavitation, 500kHz), pair 1
3. Ultrasonic drug release from bubbles inside a liver tumor (Cavitation, 500kHz), pair 2
4. Blood brain barrier opening by HIFU (Cavitation, 500kHz), pair 2
5. Separation of blood cell types (standing wave + particles, 500 kHz), pair 3
6. Separation of blood cells and fat (standing wave + particles, 500 kHz), pair 3
7. Thermal ablation of uterine fibroids by HIFU (thermal ablation, 1 MHz), pair 4
8. Treatment of essential tremor by HIFU (thermal ablation, 1 MHz), pair 4
9. Ultrasonic drug transport into tumor (travelling wave, 1 MHz), pair 5
10. Ultrasonic drug transport into eye (travelling wave, 1 MHz), pair 5
11. Bioeffects of acoustic radiation force near mobile phone loudspeaker (ARF, travelling), pair 6
12. Bioeffects of acoustic streaming near mobile phone loudspeaker (ARF, travelling), pair 6

Safety for experiments in the lab

- Your instructor (Yohann) is responsible for your safety. It is student's responsibility to follow all instructions given by instructor.
- Never turn power on on any device before the instructor has checked your setup and connections
- Never run an experiment without the instructor's permission
- Never run an experiment if the instructor's is not present in the lab
- Follow instructor's instructions on how to dispose the experimental waste (never put chemicals or particles to the sink)
- Always use safety equipment (safety goggles, protective clothing, ear protection, gloves etc.)
- No eating in the lab
- If you have any safety questions or concerns, it is better to ask than regret

Instructions outline

Cavitation, 500kHz

- Make an acoustic trap inside a petri dish based on instructor’s advice
- Visualize bubble activity with ultra-high speed camera and record a video
- From the video, analyze bubble wall radial displacement, velocity and acceleration as a function of phase
- Associate your results with the electric output power
- Is your cavitation inertial or non-inertial?
- Can you characterize the acoustic pressure?

Particles and standing wave, 500kHz

- Make an acoustic trap inside a petri dish based on instructor's advice
- Visualize particle motion with ultra-high speed camera and record a video to characterize how microparticles are trapped
- From the video, analyze particles' displacement, velocity and acceleration as a function of time
- Associate your results with the electric output power
- Can you estimate forces exerted on the particle?
- Can you characterize the acoustic pressure?

Ablation, 1 MHz

- Focus HIFU beam on a liver sample based on instructor’s advice
- Use different settings to focus sound on different locations of the sample
- Cut the sample in sections with a scalpel and take photos of the lesions
- Quantify the lesions dimension and size metrics with different settings
- Associate your results with the electric output power
- Can you characterize the acoustic pressure?

Drug delivery, 1 MHz

- Focus HIFU beam on a boiled egg sample based on instructor's advice
- Use contrast agent as a model for drug.
- Focus sound on the sample, while sample is immersed in the contrast agent solution. Use control samples without ultrasound and with pre-sonication. Make sure all samples are immersed in the drug delivery solution for the same time.
- Take photos of the samples. Cut the sample to cross-sections and take photos.
- Quantify the delivery depth or quantity from photos
- Associate your results with the electric output power
- Can you characterize the acoustic pressure?