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D4.3: Functioning RSOM2 prototype

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1) Purpose of this document

RSOM² combines the penetration depth and high resolution of Optoacoustic Mesoscopy, which allows functional, anatomical, and molecular imaging, with the cellular resolution that can be achieved with optoacoustic microscopy. This document reports on the final RSOM2 prototype achieved after grin lens and transducer selection and assembling all the optical and mechanical parts needed to build a user friendly system.

2) Final system hardware.

Figures 1 and 2 show a picture of the final system. The transducer is a spherically focused transducer and has a hole in its center to allow a fiber to pass through. A GRIN-lens is placed on the tip of the fiber in order to achieve light focusing in the imaged surface. The transducer shape is identical to the one developed in work package 2 (see also D 2.2 by Sonaxis) with a hole allowing the optical fiber and attached GRIN-lens to pass through the transducer. Several optical and mechanical elements allow for proper guidance of the laser light to the sample. The laser is a Coherent Flare NX 515-0.6-2, which has an M2 value of <1.2, with a pulse length of 1.5 ns, and 515 nm wavelength. It can operate at repetition rates up to 2000 Hz. Technical details on the microscopy part of the system can be found in deliverable 4.1 and 4.2. Details on the employed transducer can be found in deliverable 4.1. The mesoscopy parts of the RSOM2 system (bundle illumination, reconstruction algorithms, moving stages, etc.) are the same as the ones used in RSOM and can be found extensively in the following publications made by the authors of this report, e.g. <https://doi.org/10.1002/jbio.201700359> , <https://doi.org/10.1016/j.pacs.2018.02.002> and references therein.



Figure 1: Perspective picture of the RSOM2. The black box contains the laser and the optics used to bring the laser pulses to the sample. Initially, an interface unit is attached to the sample. Afterwards the scanning head is attached to the interface unit. A small amount of water is introduced in the interface unit to ensure acoustic coupling between the tissue and the transducer.

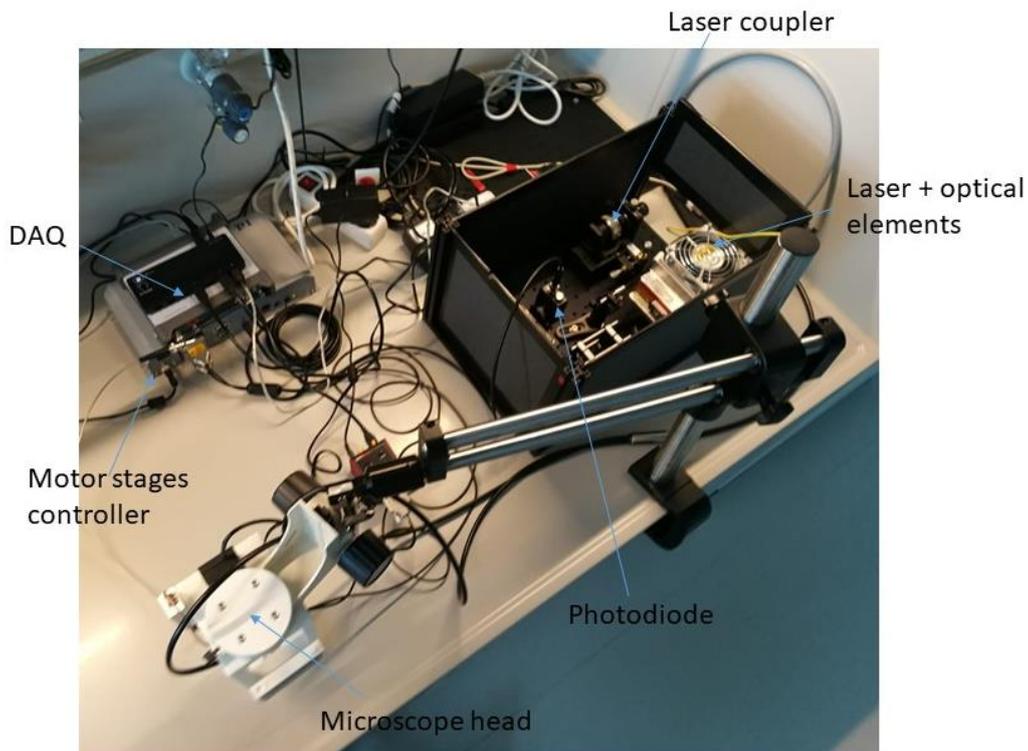


Figure 2: Top view of the RSOM2 system. The box containing the laser and optical elements for coupling is visible. The system is operated via a laptop.

3) Final system software.

A user-friendly GUI programmed in Matlab allows the system to be operated by users with low technical profile.

Figure 3 shows a print screen of the GUI. In the window “acquisition parameters”, desired parameters for raster scanning are entered, together with the name of the files and folder to store the data. Fast test scans are available and can be observed on the window next to the “acquisition parameters window”. Once the test scan achieves the desired quality, the full scan is launched.

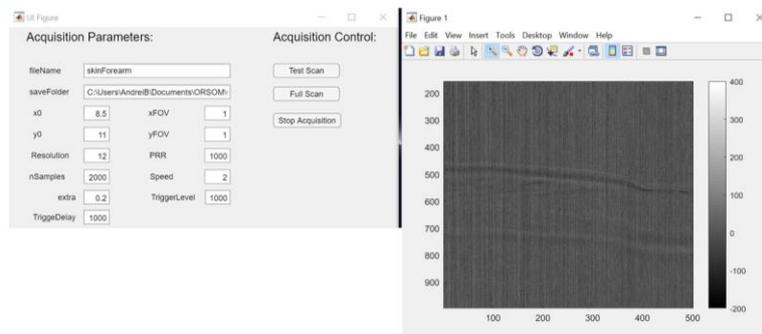


Figure3: Print screen of the user-friendly GUI programmed in Matlab. Left: acquisition control window. Right: test scan preview.

4) Furtherwork and conclusions

A functioning RSOM2 prototype was achieved and therefore D4.4 is completed. Further work will test its performance for small animal imaging and human imaging. Initial testing will be performed in Munich. This is because there is more technical expertise in Munich to respond to the possible technical amendments that may be required.