Construction of a perfusion bioreactor for brain banks

Requirements:

BA/MA student in medical engineering or life science engineering.

Topic:

Brain banking is a method that is spawning numerous downstream applications and thus serves as a cornerstone for a wide range of research and medical endeavors. E.g., understanding how individual neurons are linked together to build functional networks is known as connectomics. In order to visualize every neuron and every link, precise structural maps of connectivity are created. The examination of higher-order interactions between groups of neurons is crucial to investigate brain function and the emergence of the mind. In order to investigate trace linkages between nerve cells, whole brains are usually fixed to preserve their ultrastructure. However, long-term storage in brain banks is challenging as cryopreservation with very low temperatures is required. To avoid damage to the brain's ultrastructure, aldehyde-based perfusion protocols have been developed (e.g. McIntyre et al. (2015)). These techniques have shown promising results. Nevertheless, perfusion protocols are usually performed in a manual setup, missing acceptable standardization and process control.

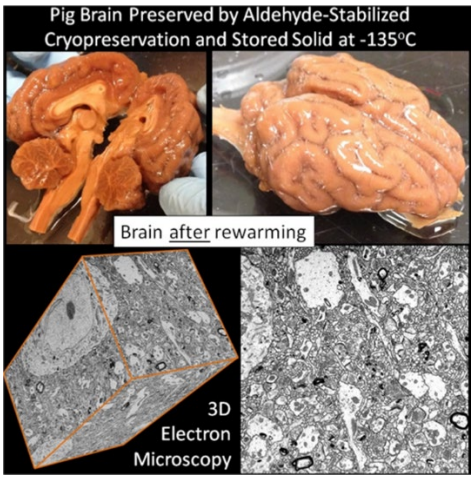

Figure 1**: Aldehyde-stabilized cryopreservation** has been independently validated by the Brain Preservation Foundation in 2018. Image retrieved from https://www.brainpreservation.org/large-mammal-announcement/

In this setting, your work will focus on the creation of a perfusion bioreactor system that process controls (a) temperature, (b) static pressure, and (c) volume flow dynamically. Further, the system will include a set of filters, a system for recirculation, and a bubble trap. You will further validate the bioreactor system on porcine brain tissue.

During the thesis, you will learn valuable insights into bioreactor technology as well as neuroscience. You will have two mentors, one from the engineering side (Paul Ritter, paul.p.ritter@fau.de) and one from the medical perspective (Alexander German, alexander.german@uk-erlangen.de).

If you feel interested and/or challenged, please contact us via mail.

Literature:

McIntyre RL, Fahy GM. Aldehyde-stabilized cryopreservation. Cryobiology. 2015 Dec;71(3):448-58. doi: 10.1016/j.cryobiol.2015.09.003. Epub 2015 Sep 25. PMID: 26408851.