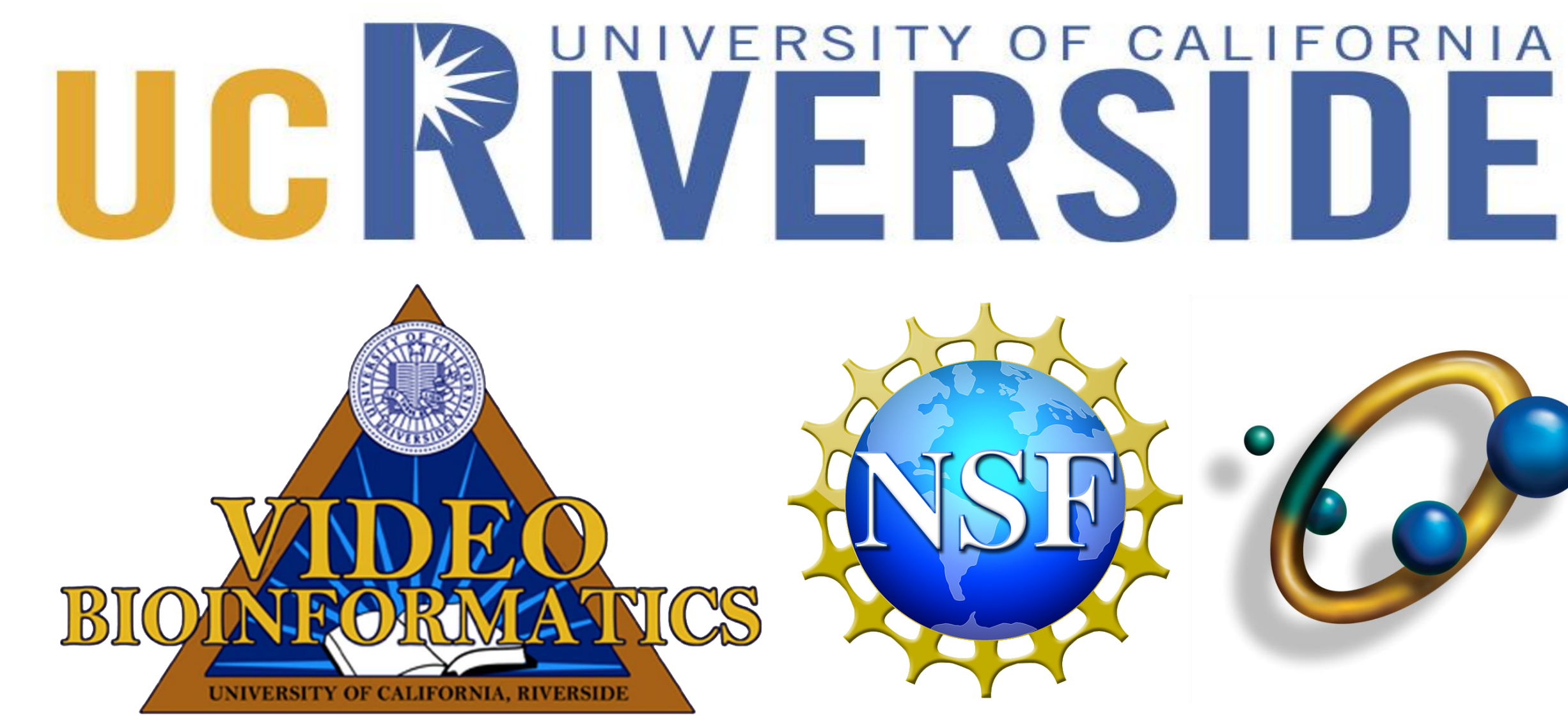# Detection of Cerebral Edema Using Optical Coherence Tomography

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Cerebral Edema

Cerebral edema, an increase in brain tissue water content, is responsible for significant morbidity and mortality in many disease states, including traumatic brain injury (TBI) and stroke.

The two types of cerebral edema are:
➢ Vasogenic edema – tissue swelling
➢ Cytotoxic (cellular) edema – glial cell swelling

Current clinical methods for detecting edema
➢ Computed tomography (CT)
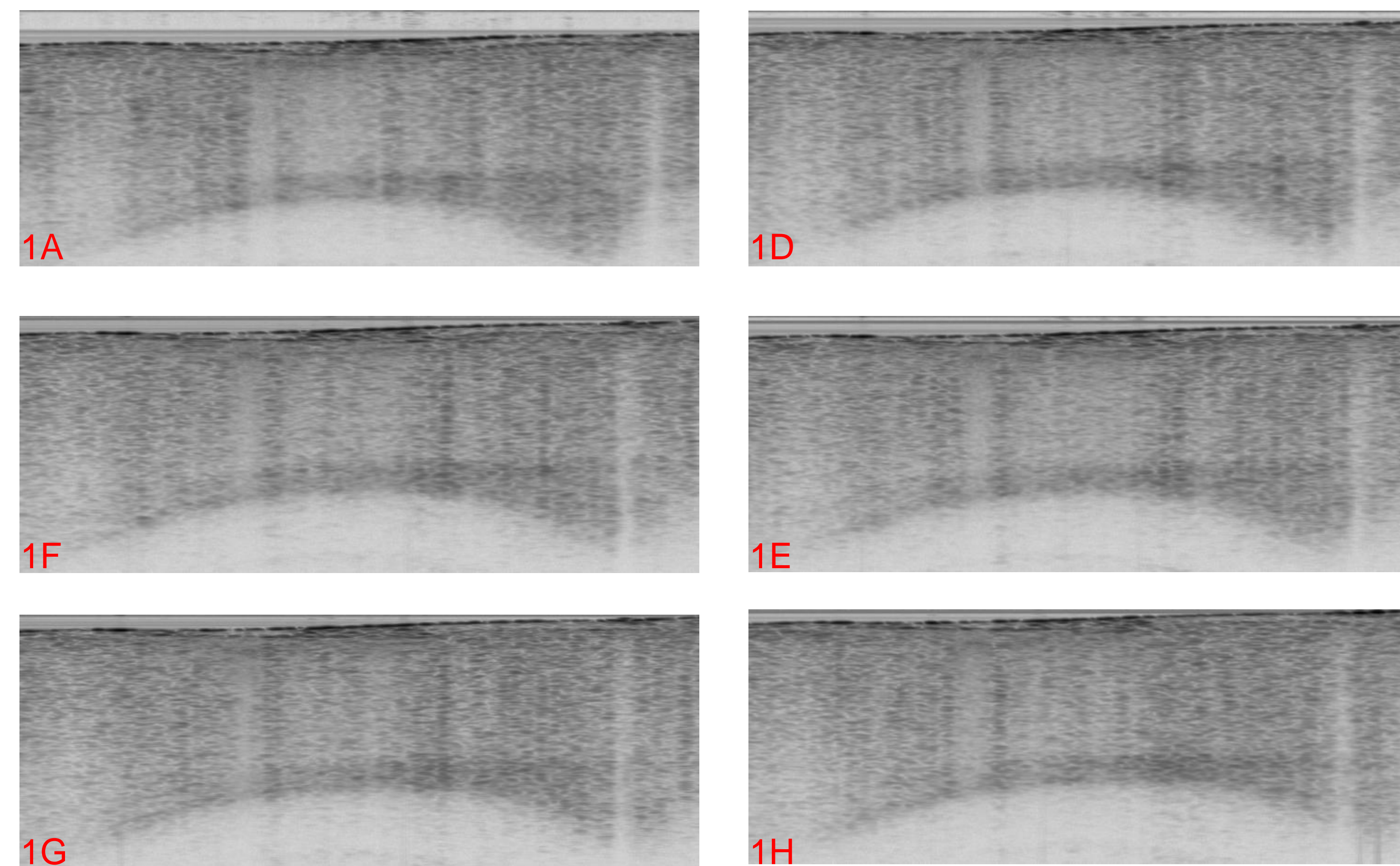➢ Magnetic resonance imaging (MRI)

Optical Coherence Tomography

Optical coherence tomography (OCT) is an imaging modality which allows for *in-vivo* continuous imaging while providing tissue specific properties, such as the extinction coefficient.
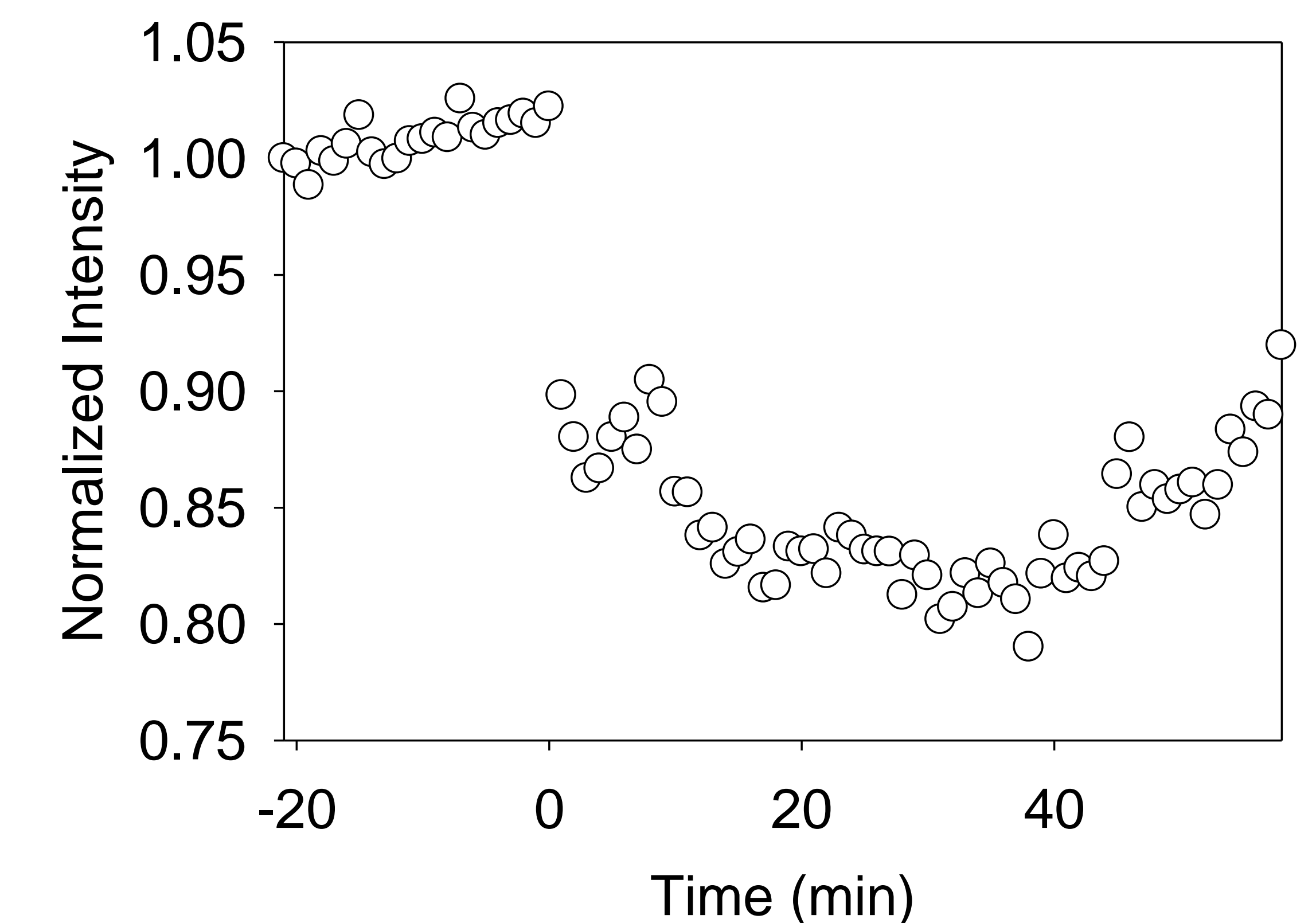
Here, OCT was utilized to detect and monitor the progression of cerebral edema by examining the transient behavior of the tissue intensity.

Inducing Cerebral Edema

Water intoxication was used to simulate severe cerebral edema. Female WT mice (10-12 weeks old) were prepared for imaging by thinning the skulls. A bolus injection of 30% of the mouse body weight in water was administered intraperitoneally.

OCT Imaging of Cerebral Edema

OCT images were collected before the injection of water to obtain baseline intensities. Imaging continued until the mice expired. Images were continuously collected during the entire experiment at a rate of 2.4 Hz. The images below are an average of all images collected in one minute. Only images for 1 minute (1A), 10 minutes (1D), 20 minutes (1E), 30 minutes (1F), 40 minutes (1G), and 50 minutes (1H) post-injection are displayed. All images are 2 mm x 1.5 mm.

Correcting for Vertical Shifts

A direct result of cerebral edema is the swelling of the brain tissue vertically. Thus, in order to appropriately analyze the intensity change as a function of time, the region of interest (ROI) needs to be corrected for the vertical shifts in the brain tissue. The vertical shift is corrected by maintaining the ROI distance from the cortical surface (top of the brain tissue).

Intensity Changes During Edema

Conclusion and Future Work

Using OCT, the increase in brain water content can be detected and monitored continuously. This provides information about the rate of swelling and may be used in selecting the appropriate therapy for patients with cerebral edema.

Future studies will include determining the optimal position of the OCT probe, determining the minimum increase of brain water content that can be detected, and extending the detection of brain water content changes to more clinically relevant models.