Raman spectroscopic tissue detection for minimally-invasive and precise medicine

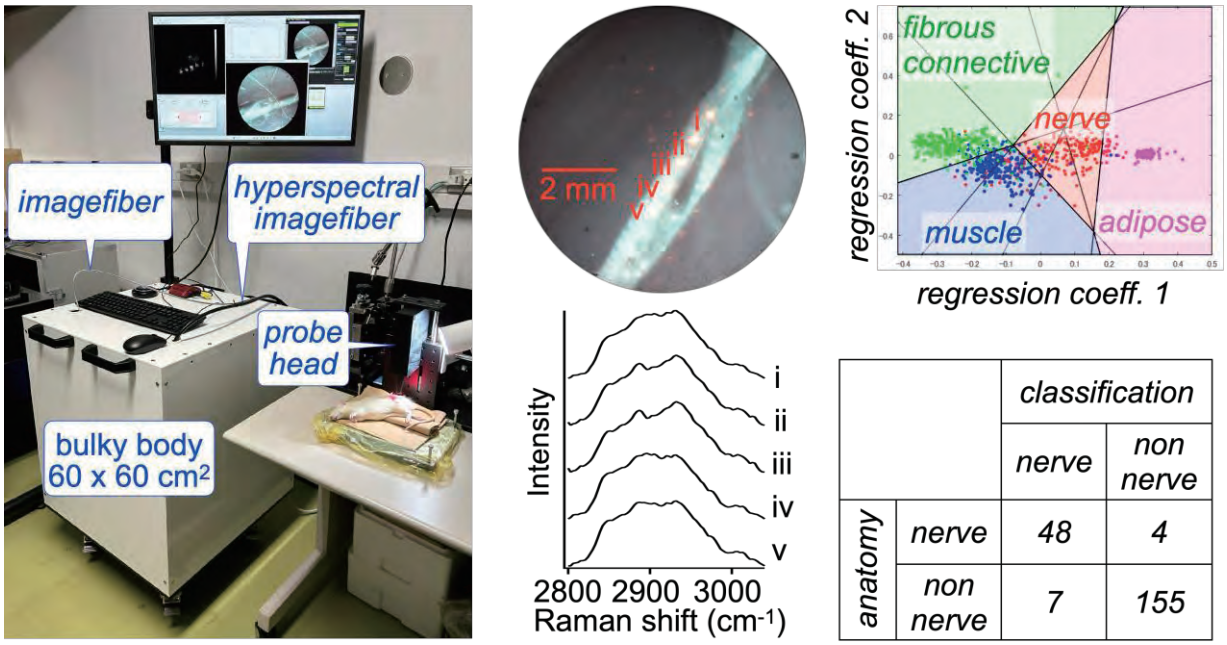
Principal Investigator	Institute for Open and Transdisciplinary Research Initiatives, The University of Osaka
	Associate Professor Yasuaki KUMAMOTO

Project Outline

Raman spectroscopy enables discrimination of cellular and tissue states or types without any sample preprocessing, simply by irradiating the target with laser light and analyzing the resulting Raman-scattered photons. However, Raman signals are inherently weak, and spatially resolved measurements require long acquisition times, which has hindered clinical application. In this study, we aim to develop a spectroscopic analysis method that allows rapid Raman mapping of biological tissues. Unlike conventional Raman mapping techniques, the proposed method measures the entire target region simultaneously. Because illumination is confined strictly to the region of interest, unnecessary light exposure to surrounding areas is avoided, thereby reducing photodamage and preventing degradation of measurement accuracy.

Building on this methodology, our goal is to realize a medical device that can prevent inadvertent injury to critical tissues and incomplete resection of pathological tissues during surgery, while also shortening the operation time. This will contribute to addressing several clinical challenges, including improving postoperative quality of life for patients and reducing the mental and physical burden on surgeons. As an initial application, we are pursuing intraoperative detection of peripheral nerves—structures that are difficult to identify visually—and are evaluating nerve-detection performance using live rat and canine models as well as human clinical specimens.

Currently, the project is in the basic research to preclinical testing phase. Two patent applications have been filed: one for the Raman mapping method and apparatus (filed domestically in January 2022; US/EU national phase entered in July 2024), and another for the portable probe implementation (filed domestically in July 2023; PCT filed in June 2024).



		classification	
		nerve	non nerve
anatomy	nerve	48	4
	non nerve	7	155

Figure. Peripheral nerve discrimination (right) achieved by simultaneous multipoint Raman spectroscopy (center) using the developed device (left).