論文の内容の要旨

論文題目　IMAGE STABILIZATION IN *IN VIVO* FLUORESCENT MICROSCOPY FOR MOLECULAR IMAGING
(分子イメージングのための
生体蛍光顕微鏡における画像安定化)

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This thesis is about image stabilization of microscope images aiming at producing motion-free images. When we wish to observe living organisms in a living animal through a microscope (invasive observation), trembling of the animal significantly disturbs the observation. This trembling motion comes from biological process such as breath, heartbeat, peristalsis, and so on. Thus, this is inevitable although the animal is typically under anesthesia when observed.

Recently, observing specific living cells or molecules within a living animal has become more and more important in biological researches, which is termed *molecular imaging*. A confocal laser scanning microscope with fluorescent probes is one of the powerful tools for molecular imaging. This method has a distinct advantage that it has very high resolution enabling cellular or sub-cellular level observations.

In this thesis, we examine hardware approach, software approach, and hybrid approach for image stabilization. In stabilization by motion synchronization, we move the objective lens to follow the motion. As a sensor for detecting the motion, we have two alternatives: a high-speed camera and a contact-type sensor which we developed. As a software approach, we stabilize the images by image processing. It consists of two steps: estimating the motion and generating motion-free images. For the estimation of the motion which is the key to the image restoration, we have two alternatives: estimation by direct matching and estimation by feature matching. Practical issues including real-time image restoration is also examined.

We propose various stabilization methods including motion synchronization, image restoration, and hybrid method. All proposed image stabilization methods have been proven to improve the microscope images in terms of observability through in vivo experiments, leading to easier and seamless observation.