Image analysis is an important element in the understanding of life science. It makes the quantification of phenomena through the extraction of meaningful information from a large amount of images, and the appropriate expression of those information, possible. To this end, I have been developing image analysis technology aimed at analyzing the developmental process of the early zebrafish embryos at a whole embryo scale and single cell resolution. By combining 3D cell tracking and functional imaging, I’m currently developing an analytical technique that can simultaneously extract multiple types of information such as cell morphology, cell motility, and cell dynamics.

I. Simultaneous multifunctional analysis of early embryonic development at a whole embryo scale and single cell resolution.

During early embryogenesis, three-dimensional remodeling of cell populations through cell migration is essential. While individual cell motility depends on extracellular signals, cell adhesion are able to be maintained, thereby controlling highly coordinated cell motility. To elucidate the principle of such a complicated form of embryogenesis, it is necessary to understand the cell dynamics of the whole embryo at a single cell resolution. To this end, I have been developing image analysis technology to analyze the developmental process of the early zebrafish embryo at a whole embryo scale and single cell resolution.

With the development of microscopic equipment, early embryonic imaging has evolved from two-dimensional, fixed specimens and partial embryonic observations to three-dimensional, live specimens and whole embryo scale. This evolution has led to an explosion in the analysis of cell migration during early embryonic development in recent years. However, conventional image analysis techniques have only been able to extract information on cell migration in early development. Therefore, I have developed an analytic method that can simultaneously extract information concerning cell migration, cell dynamics, and cell morphology at whole embryonic scale and single cell resolution.

II. Research support by image analysis

The development of imaging technology has been remarkable within life science research, and many researchers are now able to easily acquire large and complex image data sets. However, image analysis can still create hurdles for researchers, as well as bottlenecks in research. In order to solve this problem, I have been providing research support based on the following three concepts.

The first concept is quantitative image analysis based on a wealth of knowledge in imaging and statistics. For many researchers, the method of evaluating information contained in images is limited to qualitative and subjective types. Correct analysis based on knowledge of imaging and statistics supports quantitative and objective analysis. The second concept is the active utilization of image analysis technology via the application of machine learning, including deep learning. In recent years, the development of machine learning has been remarkable, and with a little training, it is possible to simplify analysis that is difficult to achieve with conventional image analysis technology. The third concept relates to the publication of explanations of image analysis to researchers in an easy-to-understand manner on the web. The contents of which range from the principles of image analysis methods to the use of image analysis software and plug-ins.