Curriculum Vitae

Name

Takeharu NAGAI, Ph.D.

Current Position

Director and Professor

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Education & Professional Experiences (Times New Roman, 11 point)

1988-1992 B.Sc. in Biology, University of Tsukuba
1992-1994 M.S. in Agricultural Sciences, University of Tsukuba
1994-1998 Ph.D. in Medicine, The University of Tokyo
1995-1998 Research fellow, JSPS
1998-2001 Researcher, RIKEN
2001-2005 Researcher, PRESTO, JST
2005-2012 Professor, Research Institute for Electronic Science, Hokkaido University
2012- Professor, SANKEN (The Institute of Scientific and Industrial Research), The University of Osaka
2014-2017 Vice Director, SANKEN (The Institute of Scientific and Industrial Research), The University of Osaka
2017-2019 Division head, Innovative Co-creation Division, Office for Industry-University Co-Creation
2017- Distinguished Professor, The University of Osaka
2018- Department head, Department of Hyperdimension Life Imaging, Open and Transdisciplinary Research Initiatives
2020 Vice Director, SANKEN (The Institute of Scientific and Industrial Research), The University of Osaka
2022- Visiting Professor, Nara Institute of Science and Technology
2022-2025 Professor, Research Institute for Electronic Science, Hokkaido University
2023-2025 CEO, LEP Inc.
2025- CTO, LEP Inc.
2026.4- Director, SANKEN, The University of Osaka

Research Interests (Times New Roman, 11 point)

-Development of optogenetic tools for manipulation and visualization of cellular functions
-Development of new microscopy system for visualization of multifunctions in living cells
-Singularity biological -Toward understanding how the rare element such as cells can drastically change the whole biological systems
-Development of light-emitting plant which could be used as an electrical power free light source

Selected Publications (※3-5 major papers)

1. Ozaki-Noma R, Wazawa T, Kakizuka T, Shidara H, Takemoto K, Nagai T. Positive-Type Reversibly Photoswitching Red Fluorescent Protein for Dual-Color Superresolution Imaging

with Single Light Exposure for Off-Switching. ACS Nano,2025
2. Hattori M, Wazawa T, Orioka M, Hiruta Y, Nagai T. Creating coveted bioluminescence colors for simultaneous multi-color bioimaging. Science Advances, 11, eadp4750, 2025
3. Ichimura T, Kakizuka T, Taniguchi Y, Ejima S, Sato Y, Itano K, Seiriki K, Hashimoto H, Sugawara K, Itoga H, Onami S, Nagai T. Volumetric trans-scale imaging of massive quantity of heterogeneous cell populations in centimeter-wide tissue and embryo eLife, 13, RP93633, 2024
4. Kusuma SH, Kakizuka T, Hattori M, Nagai T. Autonomous multicolor bioluminescence imaging in bacteria, mammalian, and plant hosts. Proc Natl Acad Sci USA,, 121, e2406358121, 2024.10
5. Temma K, Oketani R, Kubo T, Bando K, Maeda S, Sugiura K, Matsuda T, Heintzmann R, Kaminishi T, Fukuda K, Hamasaki M, Nagai T, Fujita K. Selective-plane-activation structured illumination microscopy. Nature Methods, 21, 889–896, 2024.04

Lecture Title

From Millions to One: Trans-Scale Imaging for Rare Cell Discovery

Abstract (500 words maximum)

Keywords: Trans-scale-scope, AMATERAS, rare cell discovery, minority, fluorescence

Conventional bioimaging approaches typically emphasize dominant populations within a sample, thereby overlooking rare outlier-like cells that may disproportionately influence biological systems. Increasing evidence demonstrates that such rare cells can be central drivers of processes including embryonic development, cancer progression, immune evasion, and drug resistance. However, detecting and analyzing these events requires simultaneous observation of extremely large cell populations with both high spatial resolution and temporal continuity.
To meet this challenge, we developed AMATERAS (a multi-scale/modal analytical tool for every rare activity in singularity), a high-throughput fluorescence imaging system that bridges centimeter-scale coverage with micrometer-scale resolution. By combining a 250-megapixel CMOS sensor with a 1x or 2× telecentric macro lens, AMATERAS achieves a field of view exceeding 1 cm at ~1 μm resolution, allowing single-cell tracking across more than one million cells in a single image. This system enables real-time visualization of cell migration, fate transitions, and functional responses, and is capable of detecting ultra-rare events occurring in fewer than 0.01% of cells.
Furthermore, AMATERAS is integrated with robotic arms and an incubator to enable automated, long-term imaging of adherent cells and organoids under controlled culture conditions. This facilitates continuous, unbiased monitoring of large-scale cell populations, generating data-rich trajectories for both basic and translational research.
In this presentation, I will introduce the design and performance of AMATERAS and illustrate its capacity to reveal unexpected cellular phenomena. By capturing the extraordinary within the ordinary, this platform defines a new paradigm in high-throughput biophotonics, advancing applications in regenerative medicine, oncology, and drug discovery.