

Faculty and Laboratories of Department of Mechano-Informatics

※: Professors denoted by this symbol do not accept new graduate students for the applicable academic year.

[RCAST]

denotes the professors of Research Center for Advanced Science and Technology holding adjunct professorship at School of Information Science and Technology.

[AI center]

denotes the professors of AI Center (*1) holding adjunct professorship at School of Information Science and Technology.

*1 Next Generation Artificial Intelligence Research Division, Center for Education and Research in Information Science and Technology (CERIST), and Next Generation Artificial Intelligence Research Center, The University of Tokyo.

[VR center]

denotes the professors of VR Center (*2) holding adjunct professorship at School of Information Science and Technology.

*2 Virtual Reality Educational Research Division, Center for Education and Research in Information Science and Technology (CERIST), and Virtual Reality Educational Research Center, The University of Tokyo.

Professor
Hideaki KUZUOKA



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Kuzuoka-Amemiya-Narumi Laboratory

Research on Cybernetic Interface aims to study interfaces that unite human and computer seamlessly. Our particular interest is in exploring Cybernetic Interface on the basis of Virtual Reality (VR) and Computer Supported Cooperative Work (CSCW) technologies. We focus not only on system development, but also on exploring innovative contents in application areas, and studying the impact of human-computer interaction on psychological and social science research. Specifically, we are conducting research on multi-modal/cross-modal interfaces including tactile, olfactory, and gustatory senses, human augmentation technologies to enhance human physical and cognitive abilities, social robots, and educational systems using virtual and augmented reality.

Virtual Reality / Mixed Reality

Redirected Walking techniques
 Multi-modal and Cross-modal Interfaces
 Human Augmentation with Virtual and Augmented reality
 Ghost Engineering
 (Embodiment toward Avatars and Its Effect on Perception/Cognition)
 Virtual and Augmented Reality-Based Education

Associate Professor
Tomohiro AMEMIYA
[VR Center]



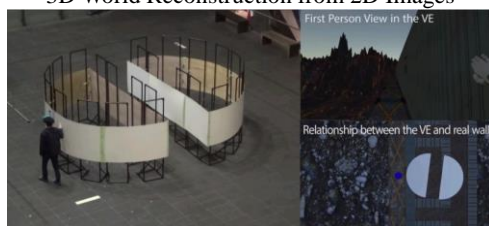
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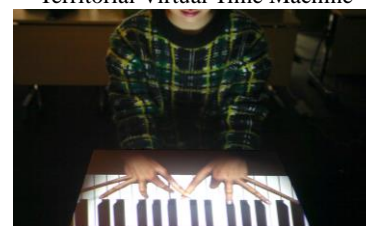
3D World Reconstruction from 2D Images



Territorial Virtual Time Machine



Redirected Walking using Visuo-haptic Interaction



Ownership toward Augmented Body

Associate Professor
Takuji NARUMI



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Computer Supported Cooperative Work (CSCW) / Human-Computer Interaction

Telepresence Systems for Enhancing Remote Communication
 Human-Robot Interaction and Social Robot
 Behavior Elicitation & Emotion Evacuation Interfaces
 Lifelog Visualization and Analysis, and Lifelog-based Future Prediction



Social robots in museum



Gustatory / Olfactory displays



"Cloning" technique for mediated group work



Emotion evocation via pseudo-bodily reactions



Takanori Fukao
Professor

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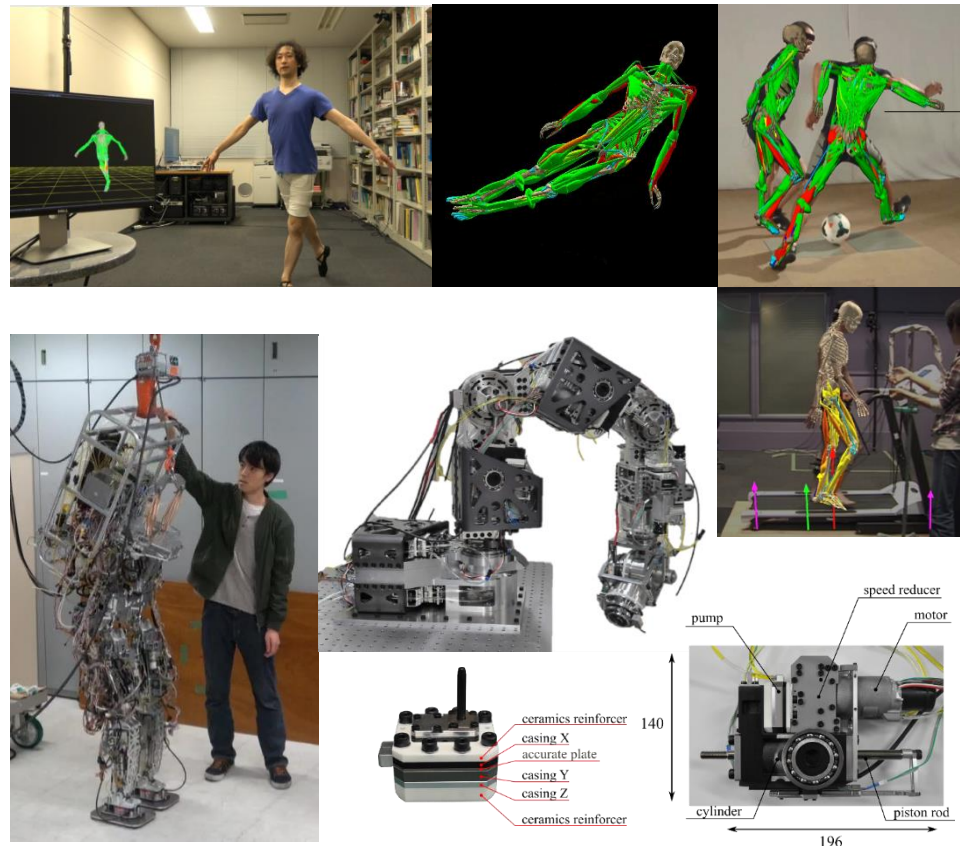
Dynamics and Control Systems Laboratory <http://www.ynl.t.u-tokyo.ac.jp/>

- (1) Highly Robust Autonomous Driving Systems of Cars and Trucks
- (2) AI-based Autonomous Harvest/Transport Systems for Vegetables and Fruits
- (3) Biomechanics: Video MoCap, Musculo-skeletal Model, Sports Analysis
- (4) Humanoid Robotics: Hydraulic Actuators, Motion Control and Soft Robotics



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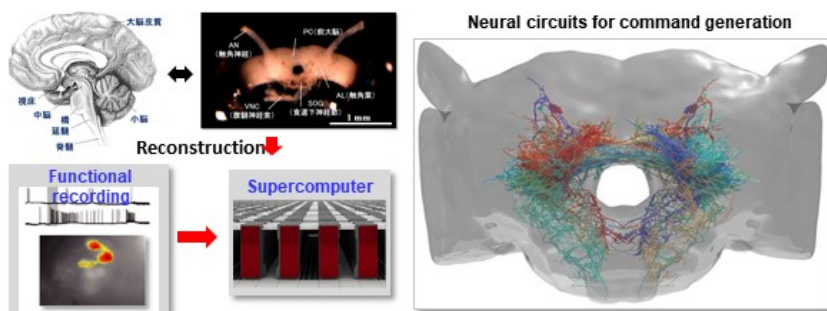
Kanzaki & Takahashi Lab

Research field: The aim of our research is to clarify the basic neural mechanisms for generating adaptive behaviors (or intelligence) using interdisciplinary approaches combining informatics, engineering and biology. As model systems, we use cultured neurons, insect brains and rat brains. Our research deals with investigating bio-machine hybrid systems, and also establishes basic technologies for controlling behavior by external commands to brain functions.

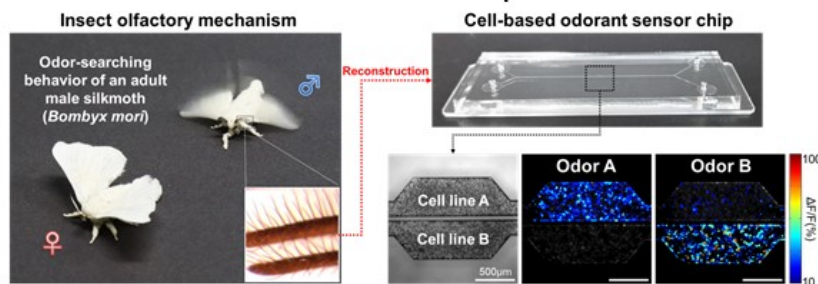
Kanzaki Group (RCAST, Komaba Research Campus)

<http://www.brain.rcast.u-tokyo.ac.jp/>

(1) Understanding elementary intelligence of insect brains



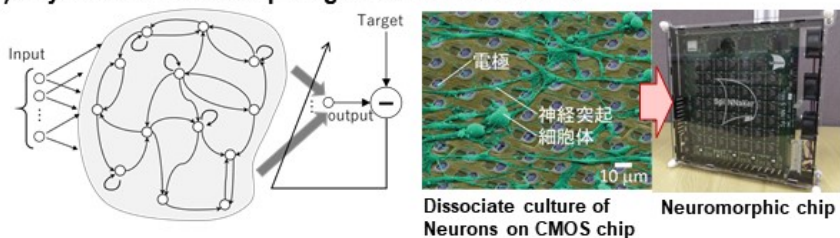
(2) Odorant sensors based on insect odorant receptors



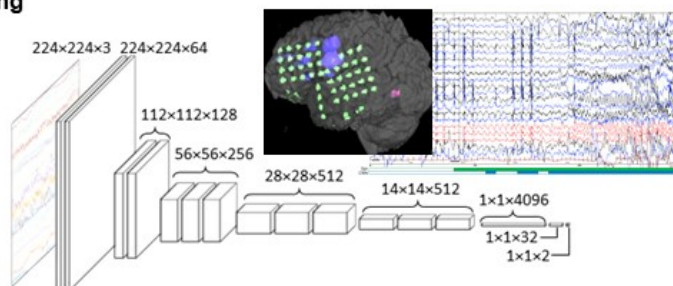
Takahashi Group (Hongo Campus)

<http://www.ne.t.u-tokyo.ac.jp/>

(3) Physical reservoir computing with neuronal tissues



(4) Neural consciousness of consciousness and learning based on functional imaging



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JSK Robotics Laboratory (Jouhou System Kougaku Laboratory)

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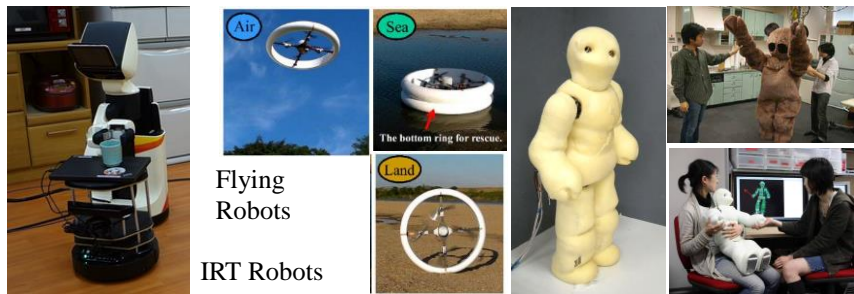
Research in this laboratory is focusing on the fundamental functions and systems necessary for future intelligent robots that will live and work in the daily life field and human society. The members are challenging something new through their own integrated robot systems and learning how to build sustainable systems for the future with each other.

- (1) **Daily life support humanoid platform** : recognition of situations in human life environments, using tools, dishes, tablewares, and appliances, learning from humans, conversation with humans, etc.
- (2) **Musculoskeletal tendon-driven humanoid** : humanlike musculoskeletal body with very many joints and numerous redundant sensors aiming at powerful and supple motions like human, design principle of humanoid body structure, autonomous development of complex sensory-motor system, etc.
- (3) **Embedded robotics devices**: soft flesh or deformable tactile sensor devices, integrated IMU sensors, perception devices, embedded CPU for flying robots, onbody communication LAN system, power system for intelligent robots. etc.
- (4) **Dynamics whole body control humanoid** : integrating high-torque, high-speed motor drive circuit, high-speed 3D recognition system, dynamics whole-body.
- (5) **IRT (Information and Robot Technology) to support human and aging society**: through fusing IT and RT systems, personal mobility robots, affectionate watching appliance are conducted for supporting the future life society
- (6) **Robot Open Software System** : design and development of open-source type intelligent robot for mobile manipulation robot.



Daily Assisteive HRP2-JSK humanoids

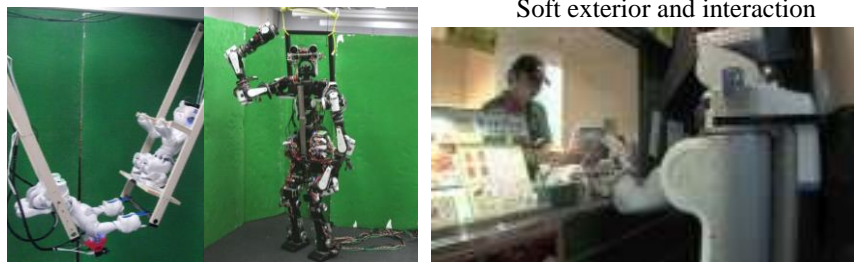
Musculoskeletal humanoids



Flying Robots

IRT Robots

Soft exterior and interaction



Dynamic whole-body control humanoid

Open software robot : PR2

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Laboratory for Intelligent Systems and Informatics (ISI)

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A Breakthrough Towards Truly Intelligent Systems in the Real World:

Towards truly effective and human beneficial intelligent systems in the complex and uncertain real world, we are trying to develop next generation AI methods based on new understanding of the principles of human intelligence, with application to real world tasks.

1. Origin of Intelligence: Constructive Study of Emergence and Development of Embodied Cognition and Behavior

Body-Brain Model and Simulated Development of Human Fetus/Infant, Baby Robot, Emergent/Instant Adaptative Behavior, Motor Development, Intrinsically Motivated Autonomous Learning, Imitation, Concept / Language Acquisition, Emergence of Consciousness, Development of Self-Other / Social Cognition.

2. Elucidating/Modeling Human Intelligence, Next Generation AI

Whole Brain Simulation, Nature/Application of Spiking Neurons, Emotion-Body-Cognition Interaction Model, Brain Science and Mathematical Modeling of Self-Esteem / Value System / Decision making / Motivation. Free Energy Principle, Advanced Deep Reinforcement Learning and Its Integration with Imitation. Acquisition of Affordances, Multi-Modal Measurement and Robot Learning of Dexterous Human Skills.

3. Musculo-Skeletal Bodies and Motor Skills

Artificial Muscles, Human/Animal Type Musculo-Skeletal Robots, Thin & Flexible Tactile Sensors, Biomechanics, Jumping & Running, Sport Motion, "Knacks" and "Focuses", Motor Learning

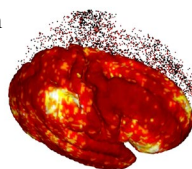
4. Soft Robotics

Soft Actuators, Printable Robots, Inflatable Robots, Soft User Interface. Bio-Inspired Robots, Continuum Arms, Co-evolution of Body & Behavior

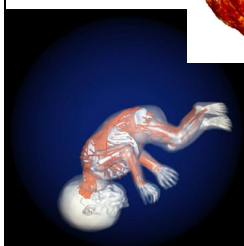
5. Science & Technology of Monitoring / Nursing, Elderly Care, Assistive Technology for People with Developmental Disorders

Monitoring & Risk Prediction of Humans Behavior/Health by Sensing & Machine Learning, Clinical Application of AI, Interactive Elderly Care Robots, Characterization of Developmental Disorders and Alleviative Technology for their Sufferings.

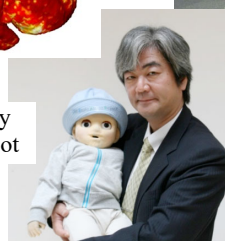
Whole Brain Simulation



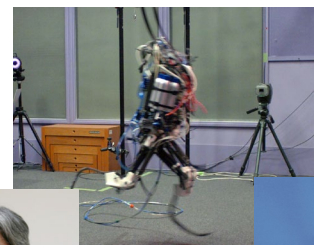
Simulated Fetus



Baby Robot



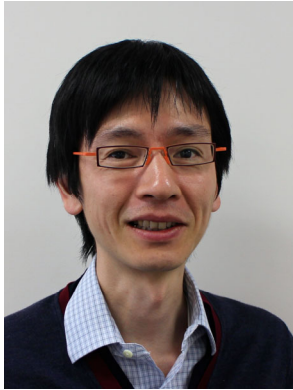
Athlete Robot



High Density Thin Tactile Sensor



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Machine Intelligence

Advanced Intelligent System for

Recognition in Real-world, Contents Generation and Knowledge Discovery

Our goal is to invent advanced intelligent systems for real-world recognition, contents generation and knowledge discovery by combining useful but infinite information in the physical space with a massive amount of data and powerful computational resources in cyberspace. To tackle this challenging problem, we utilize all resources in the area of computer science, including the mathematical basis and robotics.

1. Mathematical Basis

Information theory, machine learning, deep learning, data mining, pattern recognition, stochastic/statistical theory, time series analysis, causality analysis, learning theory, feature extraction

2. Recognition, Understanding and Thinking

Computer vision, image recognition and retrieval, 3D vision, behavior recognition, multimodal recognition, emotion understanding, natural language processing, speech and music information processing, medical information processing, big data

3. Contents Creation

Sentence generation and summarization of image and video, image generation from sentences, dialog system, automatic article generation system

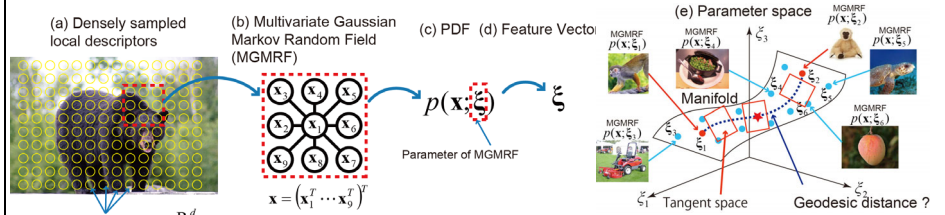
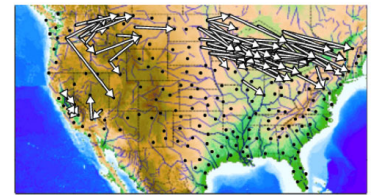


Image feature extraction based on information theory and machine learning



A silver car parked in a residential street. A brown horse standing in a lush green field.

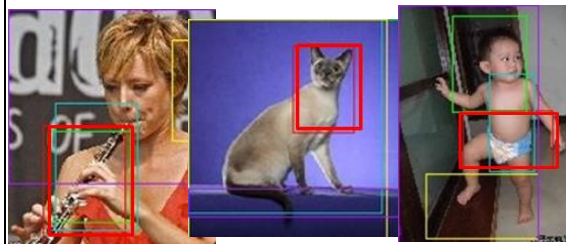
Automatic sentence generation system



Causal analysis for meteorological data

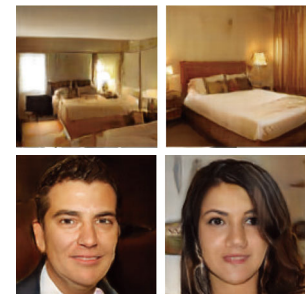


Integration of computer vision, computer graphics, and machine learning



oboe Siamese cat diaper

Large-scale image recognition system



Automatic realistic image generation of unseen object

Shoji TAKEUCHI
Professor



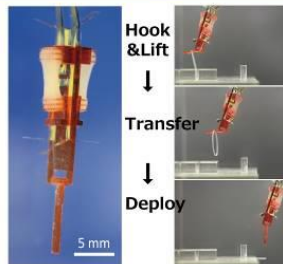
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Biohybrid System Lab.

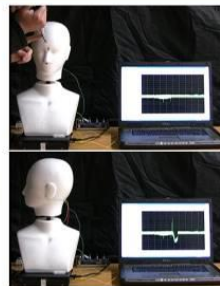
<http://www.hybrid.t.u-tokyo.ac.jp/>

Our group focuses on creating bio-hybrid systems that combine bio-functional materials with micro/nano devices. As one example, biohybrid robots powered with skeletal muscle tissues allow to engineer dynamic systems of living organisms. As another example, biohybrid sensors with recombinant cells can detect target materials with high sensitivity and selectivity. We aim to realize such hybrid systems by combining various disciplines, such as mechanics, informatics, biophysics, cell biology, and material sciences. Personnel interested in multidisciplinary research, with any of these abovementioned backgrounds, are warmly welcomed to join us.

Cyborg technology *Enhance robots with living tissue, or upgrade living body by implanting artificial materials.*



▲ A biohybrid robot with an antagonistic pair of skeletal muscle tissues reconstructed in-vitro. Contractions of the skeletal muscle tissues can be controlled via electrical stimulation.



▲ A robot says "no" to a smell upon detecting relevant odorant molecules using a cell-based sensor chip.

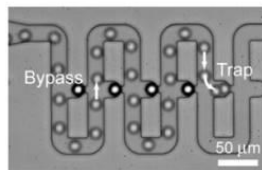


◀ Hydrogels implanted in the ear of a mouse for optical detection of blood glucose. The system can monitor blood glucose continuously, 24 hours a day.

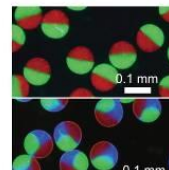


▲ Robot covered by skin tissue, which can heal its damage like what the living systems do.

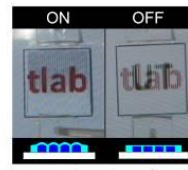
MEMS *Fabricate microdevices with refined structures and unique functions using microfabrication techniques.*



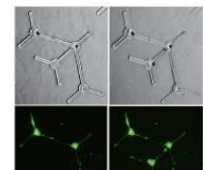
▲ Manipulate and arrange biomolecules or cells effectively using microfluidics, and achieve biological assays with unprecedented accuracy.



▲ Compartmented, uniform-sized hydrogel beads can be fabricated en masse using microfluidics.



▲ Micro lens for the dynamic ON/OFF control of 3D displays. The lens consists of deformable microchannels actuated by hydraulic pressures.



▲ Construction of arbitrary neuron networks by arranging cell-laden micro-plates.

Yuya MORIMOTO
Associate Professor

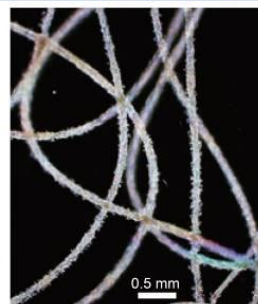


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Biofabrication *Fabricate biological "gears" and "wheels" using molecules or cells, assemble three-dimensional "machines", i.e. tissues/organs, for regenerative medicine or drug-testing models.*



▲ Process living cells into micro beads, accumulate the beads to fabricate millimeter scale 3D tissues.

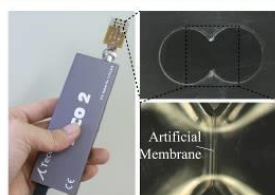


▲ Cell fiber: a thin, long, fibrous tissue fabricated using microfluidic techniques.

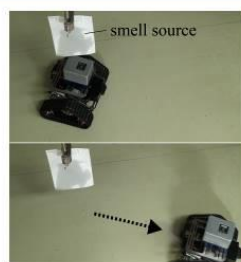


▲ A mini beef steak fabricated using cells isolated from bovine muscles.

Artificial cell membranes *Manufacture cell membranes and eventually cells from scratch for biosensing.*



▲ Portable sensor powered by an artificial cell membrane. The membrane consists of proteins derived from olfactory cells to detect smells.



◀ A robot mounted with an artificial cell membrane based odorant sensor, which can move in response to smell.

▶ Inspired by the principle of bubble guns, artificial cells can be fabricated by jetting a flow onto an artificial cell membrane.

