BIOGRAPHY

Shigeru Kuroda is an assistant professor at the Research Institute for Electronic Science (RIES) at Hokkaido University, Japan. After he received his Ph.D in Mathematics from the Hokkaido University in 2009, he was an Postdoctoral Fellow at the Cellular Information Group of the RIES during 2010-2012 and at the Future University Hakodate during 2012-2013. He became an assistant professor at the Mathematical and Physical Ethology Group of the RIES in 2013. His current research interests are in the application of dynamical systems theory to the living systems, especially, animal locomotion, ethology of unicellular organisms and evolution of neural systems.

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Dynamic gait generation in crawling locomotion: observation and modelling

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Crawling is a fundamental method of biological locomotion in invertebrates, including both limbless and legged organisms. There are several methods of crawling on a solid surface, depending on the locomotory equipment available : ciliary, pedal, peristaltic, undulatory and many-legged locomotion. The propulsive machinery is very different among crawlers with locomotory waves, but the kinetic similarity of peristaltic waves in Annelida to pedal waves in Mollusca or leg-density waves in Myriapoda has been correctly pointed out in diagrammatic explanations [1]. Recently, mechanical considerations reveal (1) that leg-density waves play the same role as peristaltic waves in limbless crawlers, and (2) that locomotory waves push the body forward or backward by a common mechanism [2, 3]. It is generally considered that the direction of locomotory wave is fixed for a given species. For example, millipedes show postero-anterior waves and centipedes show antero-posterior waves during forward locomotion. However, by recording and detailed analysis of the gait patterns of a species of centipedes in various situations, we found that the direction of the locomotory waves can change depending on the situations [4]. In this talk, we would like to first introduce the crawling locomotion using locomotory waves and an 1-dim simple mechanical model for the crawlers [2,3]. Then, we will present an extended model equipped with biologically feasible local feedbacks, which demonstrates a possible underlying mechanism for dynamic gait generation in the crawlers [4]. Discussion made on physiological role of the dynamic gait generation from a viewpoint of general mechanics of environment-coupled animal locomotion.

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