

Biologically Inspired Robot Motion Generation

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Abstract

Motion in animals and humans is generated by a neural network in contrast to a digital program as used in computers. For example, it has been found that some motions of animals and humans can be generated by a neural network called a Central Pattern Generator (CPG) that produces rhythmic excitation. We created a model of such a neural network from an engineering perspective and applied the model to motion generation in robots and, in particular, to motion generation in humanoid robots. This fundamental research plays an important role in the modeling of neural networks. If this neural-network model can be applied to other forms of information processing, such as speech recognition and visual information processing, it will become a very promising model. At present, we are applying a mathematical model of a neural network obtained by this research to other types of work performed by living organisms, that is, work involving actual neural networks, such as audio information processing, pattern recognition, associative memory, and logical information processing. One example is the development of pedometers for use in cell phones.

Technology

Motion generation and information processing is normally achieved by combining many basic operations such as the four basic arithmetic operations and differentiation/integration. In contrast, the neural-network model developed in our research features only four operations: delay, summation, amplification, and switching. Of these, delay and switching each feature digital and analog types. There are no other operations such as division or integration. We have succeeded in creating motion by combining only these basic operations. In addition, we are coming to understand that this model can be used for other kinds of information processing. If this model can be used as a basis for performing all of the information processing required by a robot, it will become a basic element of robot software in the future.

Application Examples

- HOAP Motion Demonstration
- Humanoid for Open Architecture Platform (HOAP) motion generation
- NueROMA general-purpose motion-generation software, option library
- Research of human-friendly robot architecture
- Pedometers

