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Chapter V

Modelling of Some Aspects of Skilled Locomotor Behaviour Using Artificial Neural Networks

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ABSTRACT

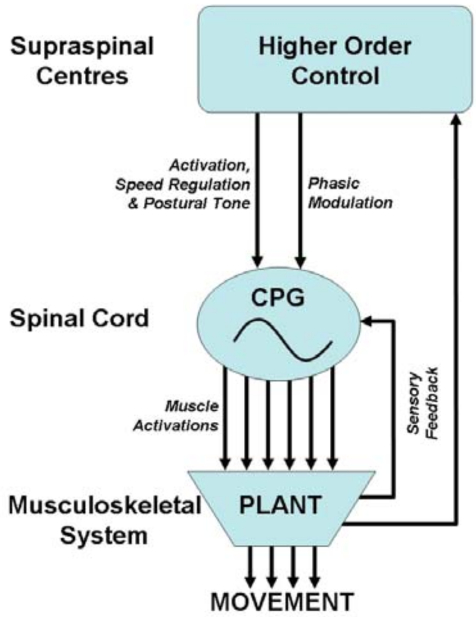
Modelling the control of locomotor movements can take place at many different levels and represent gaits of different animal species. In many cases, these models attempt to capture the theoretical constructs for generating rhythmical motor patterns gained from neurophysiological studies. This chapter examines the use of artificial neural networks to gain insights into the control of walking movements. Two models discussed simplify the pathways and structures responsible for forming these fundamental cyclical movements, and capture the global transformations between intended goals and action. The use of computational models permits researchers to address certain questions that cannot be empirically tested using current experimental techniques.

INTRODUCTION

Legged locomotion affords great flexibility in travelling through complex environments as the use of isolated footholds permits a wider selection of travel paths. In contrast to vehicles or animals that utilize slithering, rolling or gliding movements and tend to maintain continuous ground contact, legged locomotion brings the ability to step over and around obstructions, as well as quickly alter the direction and location of force application. This flexibility of walking does come with the added cost of maintaining balance and support as the number of supporting limbs changes along with the configuration of the support base. The ability to coordinate the multitude of muscles acting at different joints to integrate the propulsive and postural objectives is impressive. Researchers have long been intrigued by how the nervous system controls this intricate task of legged locomotion.

Much of the knowledge regarding neural control of legged locomotion has been obtained through animal experiments. Isolation, lesion and stimulation studies have attempted to identify which neural structures and what information are necessary for the production of locomotor activity. These preparations have shown that the basic locomotor patterns occur in the absence of higher brain centres and that sensory information is not essential (see reviews by Delcomyn, 1980; Grillner, 1985; Patla, 1998). It is these findings which have formed the concept of central pattern generators (CPGs). It is proposed that the muscle activation patterns are produced by a group of neurons

Figure 1. A conceptual model for the control of locomotion



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