Abstract-

The output of the spinal central pattern generator (CPG) for mammalian locomotion is highly variable in the fictive preparation. A first step in comparing models of the CPG to the output of the biological CPG is to create models having variable output.

We have chosen to model a spinal CPG designed to create the biphasic output observed in multi-joint muscles such as Semitendinosis in cat. Two types of biphasic model networks are described herein. Each model works in a fundamentally different way and follows principles plausible for possible CPG construction. The first model works like a clock and is composed of a recurrent network of identical neurons. The second model works by feedback (time delayed inhibiton) within a simulated CPG.

To each model we have added white noise. Noise serves to highlight differences in the way each of the models is creating its output. The models with noise are statistically differentiable using tests similar to those used on the output of the biological CPG. Modeled neurons are biophysically abstracted, and identical in the two model types.

1, The presented models are able to correctly describe cycle period length variability.

2, The cycle period of each of the models exhibits different coefficients of variation for the individual parts/fractions of the step cycle. Differences in the coefficients of variation of the parts of the step cycle are caused by the connectivities of the models. Specifically, models creating the output using a recurrent network have parts of the step cycle which vary the same amount. Models creating the output using feedback have parts of the step cycle showing more or less variablity.

3, The various parts/fractions of the step cycle also exhibit different correlations when compared together. These differences in the correlations between the fractions of the step cycle serve to identify how the various models are creating the observed output. Specifically, models creating the output using a recurrent network have parts of the step cycle varying independently. Models creating the output using feedback have correlation structures where some aspects of the step cycle are strongly linked to one another.

In the models presented herein it is possible to determine which of two model architectures has created an observed output on the basis of differences in variability and correlation between parts of the step cycle. This is a useful tool in a situation like the one currently confronting the study of the mammalian CPG where we know very much about the output but very little about the neuronal network creating it. Differing model architectures have statistically differentiable outputs. These outputs can then be compared to the statistics of the output of the actual system and perhaps provide clues as to the structure of the architecture which created them.