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ANALYSIS OF DISCHARGE PATTERNS OF SUBTHALAMIC NUCLEUS AND EXTERNAL GLOBUS PALLIDUS COUPLING IN PARKINSON CONDITION USING PARTICLE SWARM OPTIMIZATION ALGORITHM

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Abstract. Parkinson disease is characterized by movement disorder of certain body parts. In this disease, part of the brain known as basal ganglia is affected the most. In this paper, a coupled model of subthalamic nucleus and external globus pallidus (STN-GPe) is considered. It consists of the study of discharge patterns of a primate suffering with Parkinson disease and its comparison with the discharge patterns of a healthy primate. Non-uniform lags are known to be present in discharge patterns of a Parkinson primate. Membrane potential of external globus pallidus for potassium $(V_K)_{GP_e}$, membrane potential of external globus pallidus for sodium $(V_{Na})_{GP_e}$, external globus pallidus current (I_{GP_e}) and synaptic conductance from STN to GPe (g_{sg}) are the four key parameters of the coupled model affecting computing the discharge patterns. These parameters have been optimized so that discharge patterns of a Parkinson primate mimic the discharge patterns of a healthy primate. The optimization has been done using particle swarm optimization for a time span of 50 msec and 100 msec. The results are validated by computing correlation coefficient between the two discharge patterns. The value obtained for correlation coefficient is 0.99, showing a very high similarity between the two discharge patterns and the removal of lags between them.

Keywords. Discharges patterns, globus pallidus, Parkinson disease, particle swarm optimization, subthalamic nucleus

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