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Phase reduction analysis of coupled neural oscillators: application to epileptic seizure dynamics DAISUKE TAKESHITA, University of Missouri at St. Louis, YASUOMI SATO, J.W. Goethe-University, SONYA BAHAR, University of Missouri at St. Louis — Epileptic seizures are generally held to be result from excess and synchronized neural activity. To investigate how seizures initiate, we develop a model of a neocortical network based on a model suggested by Wilson [1]. We simulate the effect of the potassium channel blocker 4-aminopyridine, which is often used in experiments to induce epileptic seizures, by decreasing the conductance of the potassium channels (g_K) in neurons in our model. We applied phase reduction to the Wilson model to study how g_K in the model affects the stability of the phase difference. At a normal value of g_K, the stable phase difference is small, but the neurons are not exactly in phase. At low g_K, in-phase and out-of-phase firing patterns become simultaneously stable. We constructed a network of 20 by 20 neurons. By decreasing $g_K$to zero, a dramatic increase in the amplitude of mean field was observed. This is due to the fact that in-phase firing becomes stable at low g_K. The pattern was similar to local field potential in 4-aminopyridine induced seizures. Therefore, it was concluded that the neural activity in drug-induced seizure may be caused by a bifurcation in stable phase differences between neurons. [1] Wilson H.R., J. Theor. Biol. (1999) 200, 375-388 [2] Ermentrout, G.B. and Kopell, N., SIAM J. Math. Anal. (1984), 215-237

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