INHIBITORY INTERNEURONS MAY HELP SYNCHRONIZE FIRING OF POSTSYNAPTIC CELLS. W.W. Lytton and T.J. Sejnowski. Salk Institute, La Jolla, Ca 92037.

Phase locking within groups of neurons is a ubiquitous phenomenon in the central nervous system. This synchronization may reflect the operation of a central oscillator that owes its periodicity to the intrinsic properties of individual cells or it may be a resonance property of small neuronal networks. We studied a model of a cortical pyramidal cell that had Hodgkin-Huxley type sodium and potassium channels. Frequency entrainment was seen to a rapid train of brief, strong (20-100 nS) compound inhibitory postsynaptic potentials (IPSP) onto proximal apical dendritic shaft, soma or axon initial segment. The IPSP in this case modulated postsynaptic cell behaviour by either increasing or decreasing the rate of firing. Facilitation by the IPSP was caused by activation of sodium channels and turning off potassium channels, both reducing the threshold to firing. Using an intermediate sized IPSP (60 nS), entrainment to a 40 Hz input frequency occured when the initial rate of firing of the postsynaptic cell was between 32 and 47 Hz. The phase relation between the inhibitory cell and the postsynaptic cell generally varied from $\pi/2$ to π depending on the initial rate of firing of the postsynaptic cell. Phase locking could also be demonstrated in cells which initially showed irregular firing due to uncorrelated synaptic input. The phase locking of cell firing observed in visual cortex in response to a visual stimulus may involve these facilitatory IPSP effects in combination with direct excitatory connections. Thalamic rhythms such as spindling involve inhibitory projections from the reticular nucleus that may utilize similar mechanisms.