A novel approach to interneuronal heterogeneity: Diversity beyond means and variances

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GABA-releasing interneurons constitute a heterogeneous group of cells that play pivotal roles in the regulation of the activity of principal cells activity. Previous results (Aradi et al. 2002, Aradi and Soltesz 2002) showed that the heterogeneity of interneuronal populations is an important property of neural networks. Here, we adopted an entropy-based measure of diversity from information theory. Different diversity values, with the same population mean and cell-to-cell variance, implicate distinct clusterization of an particular interneuronal property. Here we tested the hypothesis that changing the diversity of an interneuronal parameter, without altering mean and variance values across the population, affect the principal cell firing activity. Biophysically realistic model simulations and dynamic clamp experiments showed that changes in the diversity in IPSC amplitude and inter-event intervals can significantly alter the excitability of principal cells in a predictable manner. These computational and experimental data demonstrate that the interneuronal diversity, in addition to mean and variance values, can be an important parameter of neural networks. The study was supported by the NIH (NS35915 to I.S.).