The generation of oscillations in networks of electrically coupled cells

By Loewenstein
Created 2/3/2011
By Loewenstein February 3, 2011


Abstract:

In several biological systems, the electrical coupling of nonoscillating cells generates synchronized membrane potential oscillations. Because the isolated cell is nonoscillating and electrical coupling tends to equalize the membrane potentials of the coupled cells, the mechanism underlying these oscillations is unclear. Here we present a dynamic mechanism by which the electrical coupling of identical nonoscillating cells can generate synchronous membrane potential oscillations. We demonstrate this mechanism by constructing a biologically feasible model of electrically coupled cells, characterized by an excitable membrane and calcium dynamics. We show that strong electrical coupling in this network generates multiple oscillatory states with different spatio-temporal patterns and discuss their possible role in the cooperative computations performed by the system.

Journal:
Proceedings of the National Academy of Sciences of the United States of America

Volume:
98

Pagination:
8095?8100

Notes:
{PMID:} 11427705

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- PDF (139.78 KB)
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