Meijer, Hil G. E.; **Eissa, Tahra L.**; **Kiewiet, Bert**; **Neuman, Jeremy F.**; **Schevon, Catherine A.**; **Emerson, Ronald G.**; **Goodman, Robert R.**; **McKhann, Guy M.**; **Marcuccilli, Charles J.**; **Tryba, Andrew K.**; **Cowan, Jack D.**; **van Gils, Stephan A.**; **van Drongelen, Wim**

Modeling focal epileptic activity in the Wilson-cowan model with depolarization block.

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Summary: Measurements of neuronal signals during human seizure activity and evoked epileptic activity in experimental models suggest that, in these pathological states, the individual nerve cells experience an activity driven depolarization block, i.e., they saturate. We examined the effect of such a saturation in the Wilson-Cowan formalism by adapting the nonlinear activation function; we substituted the commonly applied sigmoid for a Gaussian function. We discuss experimental recordings during a seizure that support this substitution. Next we perform a bifurcation analysis on the Wilson-Cowan model with a Gaussian activation function. The main effect is an additional stable equilibrium with high excitatory and low inhibitory activity. Analysis of coupled local networks then shows that such high activity can stay localized or spread. Specifically, in a spatial continuum we show a wavefront with inhibition leading followed by excitatory activity. We relate our model simulations to observations of spreading activity during seizures.

MSC:

92C20 Neural biology
92C50 Medical applications (general)

Keywords:

focal epilepsy; activation function; depolarization block; bifurcation analysis

Software:

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