

**Jimenez, Nicolas D.; Mihalas, Stefan; Brown, Richard; Niebur, Ernst; Rubin, Jonathan**  
**Locally contractive dynamics in generalized integrate-and-fire neurons.** (English)

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This paper considers a generalisation of an integrate-and-fire neuron, with the inclusion of internal, spike-induced, currents which could model spike frequency adaptation, for example. The model has the form of a set of linear differential equations, together with several update rules that are applied when the neuron fires. External input to the neuron is constant. Thus the dynamics can be solved exactly between firing times, and the model reduced to a discrete map. For the particular case studied, the map is one-dimensional. This map is analysed in considerable detail, allowing the authors to determine conditions under which the neuron fires periodically or in bursts, and parameter values at which transitions between these behaviours occur. The map is shown to be piecewise contractive, a property which is used extensively in the authors' analysis.

Reviewer: Carlo Laing (Auckland)

**MSC:**

- [37E05](#) Dynamical systems involving maps of the interval (piecewise continuous, continuous, smooth)
- [92C20](#) Neural biology
- [92B25](#) Biological rhythms and synchronization
- [34C25](#) Periodic solutions to ordinary differential equations
- [34A37](#) Ordinary differential equations with impulses

Cited in **5** Documents

**Keywords:**

integrate-and-fire; hybrid dynamical systems; bursting; contraction analysis; piece-wise contractions

**Full Text:** [DOI](#)