Jump detection in ecological data series using nonlinear dynamics of extended systems

Adrian Jacobo, Pere Colet and Emilio Hernandez-García

Institut Mediterrani d'Estudis Avançats (IMEDEA,
CSIC-UIB), Campus Universitat de les Illes Balears, E-07122 Palma
de Mallorca.
jacobo@imedea.uib.es http://www.imedea.uib.es/physdept/

It has been previously shown, in the context of nonlinear optics,
that a nonlinear nonlinear extended system can be used as a filter
to reduce the noise and amplify the contrast of an image [1]. Here
we extend this idea to a general nonlinear extended system and
apply this technique to the analysis of temporal series of
ecological data.

The figure on the left shows a series of data with a jump, the
image on the center shows the same image with added noise, and the
image on the right shows the filtered data where the jump is
magnified and the noise is filtered. This processing was done
using a Giznburg-Landau equation:

$$\partial_t \psi = a * \nabla^2 \psi + \psi - \psi^3 + h - h_0$$

where h is the data serie to be filtered and ψ in the
stationary state is the filtered data.
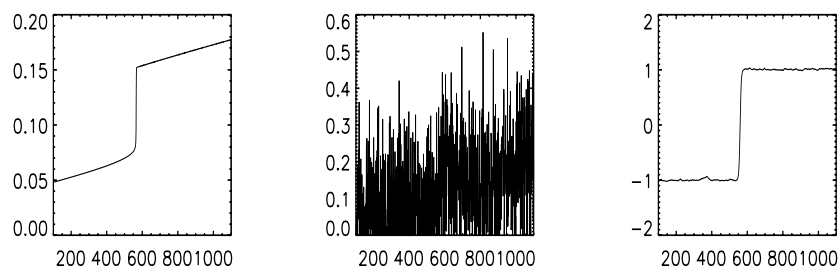
[1]Pierre Scotto, Pere Colet, and Maxi San Miguel, Opt. Lett.

28, 1695 (2003). Adrian Jacobo, Pere Colet, Pierre Scotto and Maxi San Miguel, Appl. Phys B. **81**, 955 (2005)