Introduction
We have observed that a simple autonomous Boolean-like network with time delays can display chaos. The network is realized using three high-speed, commercially available logic gates that feed back to each other with independent delays.

Chaos
For some applications it is important to verify whether the signals are deterministic chaos or amplified noise or quasi-periodic oscillations. In chaotic systems trajectories that are close in phase space separate at an exponentially increasing rate.

Bifurcation Diagrams
The delay times change with the supply voltage used in the circuit. We have used the supply voltage as a bifurcation parameter to change the dynamics, for instance, from chaotic to periodic.

Models
The theory of Boolean delay equations [1,2] cannot explain periodic windows in the bifurcation diagram. Finite response time of the gates and other non-ideal effects are necessary to have stable periodic orbits while scanning the relative values of the delay times. We have used continuous models for the analog voltages produced by CMOS gates.

References