

# IEICE Proceeding Series

Loop structure and cluster synchronization of dynamical networks with time-delayed couplings

Wolfgang Kinzel, Ido Kanter

Vol. 1 pp. 65-65

Publication Date: 2014/03/17

Online ISSN: 2188-5079

Downloaded from [www.proceeding.ieice.org](http://www.proceeding.ieice.org)



## **Loop structure and cluster synchronization of dynamical networks with time-delayed couplings**

Wolfgang Kinzel and Ido Kanter

Institute of Theoretical Physics, University of Würzburg  
Am Hubland, 97074 Würzburg, Germany

Email: kinzel@physik.uni-wuerzburg.de

### **Abstract–**

Nonlinear networks with time-delayed couplings can synchronize to a common chaotic trajectory. If the delay time is larger than the internal time scales of the individual units, the stability of chaos synchronization is determined by the eigenvalue gap of the coupling matrix and the maximal Lyapunov exponent of a corresponding single unit with self-feedback. The eigenvalue gap is related to the global loop structure of the graph of the network, in particular to the greatest common divisor (GCD) of the lengths of the loops. The GCD determines the number of synchronized clusters, as well. We demonstrate this effect for iterated maps, semiconductor lasers and linear stochastic networks.

### **Reference:**

Synchronization of unidirectional time delay chaotic networks and the greatest common divisor  
I. Kanter, M. Zigzag, A. Englert, F. Geissler and W. Kinzel  
EPL, **93** (2011) 60003