Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Hysteretic transitions in the Kuramoto model with inertia[1]
ALESSANDRO TORCINI, SIMONA OLMI, Istituto dei Sistemi Complessi, CNR, Sesto Fiorentino, Italy, ADRIAN NAVAS, Centre for Biomedical Technology (UPM) 28922 Pozuelo de Alarcon, Madrid, Spain, STEFANO BOCCALETTI, Istituto dei Sistemi Complessi, CNR, Sesto Fiorentino, Italy — We report finite size numerical investigations and mean field analysis of a Kuramoto model with inertia for fully coupled and diluted systems. In particular, we examine the transition from incoherence to coherence for increasingly large system size and inertia. For sufficiently large inertia the transition is hysteretic and within the hysteretic region clusters of locked oscillators of various sizes and different levels of synchronization coexist. A modification of the mean field theory developed by Tanaka, Lichtenberg, and Oishi allows to derive the synchronization curve associated to each of these clusters. We have also investigated numerically the limits of existence of the coherent and of the incoherent solutions. The minimal coupling required to observe the coherent state is largely independent of the system size and it saturates to a constant value already for moderately large inertia values. The incoherent state is observable up to a critical coupling whose value saturates for large inertia and for finite system sizes, while in the thermodinamic limit this critical value diverges proportionally to the mass. By increasing the inertia the transition becomes more complex, and the synchronization occurs via the emergence of clusters of coherently drifting oscillators.

[1]Financial support has been provided by the Italian Ministry of University and Research within the project CRISIS LAB PNR 2011-2013

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Date submitted: 11 Nov 2014 Electronic form version 1.4