How to suppress undesired synchronization

Supplementary Information

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SUPPLEMENTARY TABLE

Network	Nodes	Average Degree	Max Degree
The Internet	40028	2.36	259
C. elegans	283	17.39	115

TABLE S1. Number of nodes, average degree, and maximum degree for network of Routers in the Internet and the neural network of the *C. elegans*.

SUPPLEMENTARY FIGURES

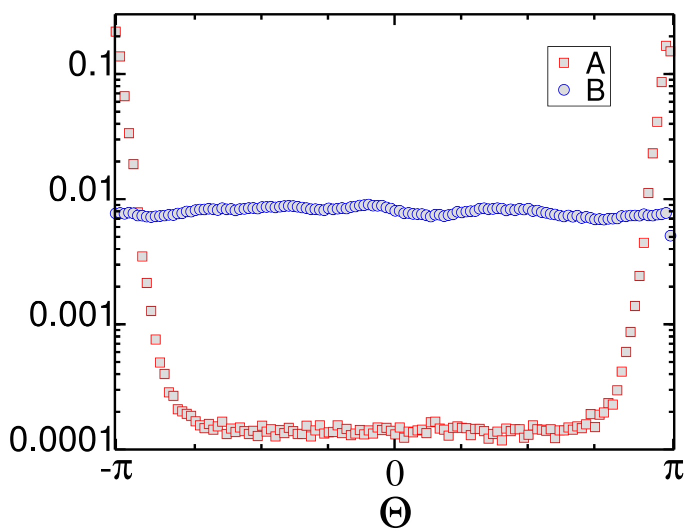

FIG. S1. **Distribution of oscillator phases**. Histogram of the phase of oscillators for $t = 100$. Curves represent oscillators according to the mean-field (A) and pairwise (B) models. While mean-field contrarians are frozen in $-\pi$ and π, pairwise contrarians are uniformly distributed through all phases. Results are averages over 1000 ER networks of 1000 oscillators each, where $\rho = 0.1$ and $\lambda = 1.0$.

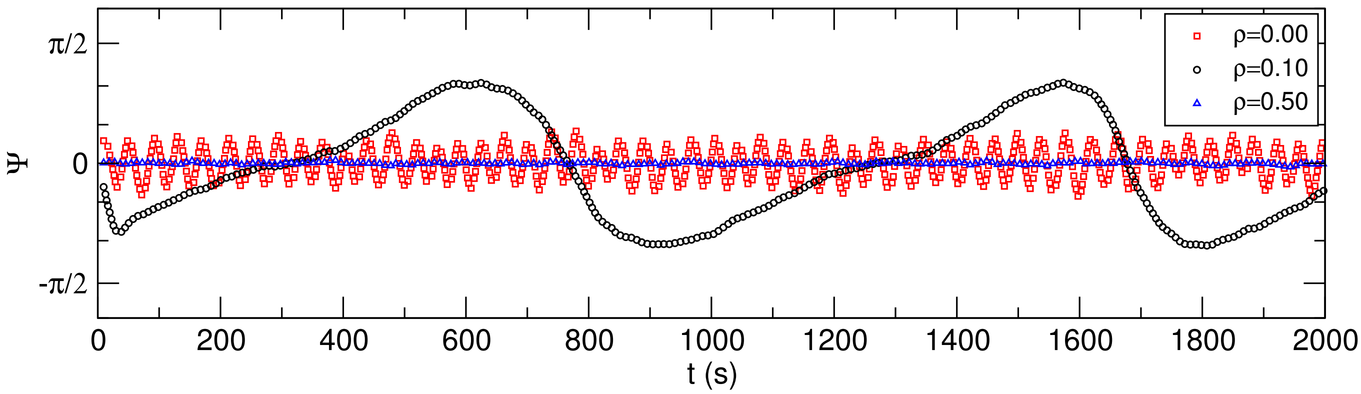

FIG. S2. **Average phase of oscillators with different fractions of pairwise ρ contrarians**. Time dependence of the average phase of oscillators for different fractions of randomly assigned contrarians. The amplitude of the wave goes to zero with the fraction contrarians oscillators.

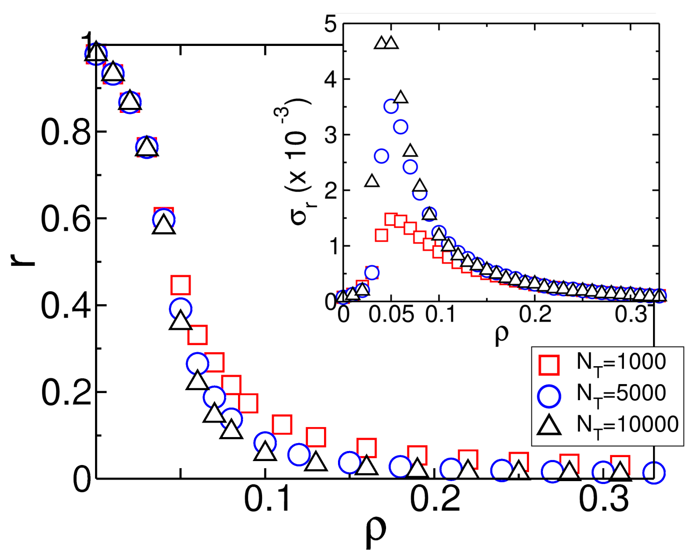

FIG. S3. **Impact of pairwise contrarians assigned to the nodes of highest degrees on the synchronization of ER networks of average degree four.** Order parameter r dependence on the fraction of contrarians ρ for different network sizes showing a suppression of synchronization after the introduction of pairwise contrarians. The inset is the standard-deviation of r showing a transition around $\rho = 0.05$, much smaller than ramdomly assigned contrarians.

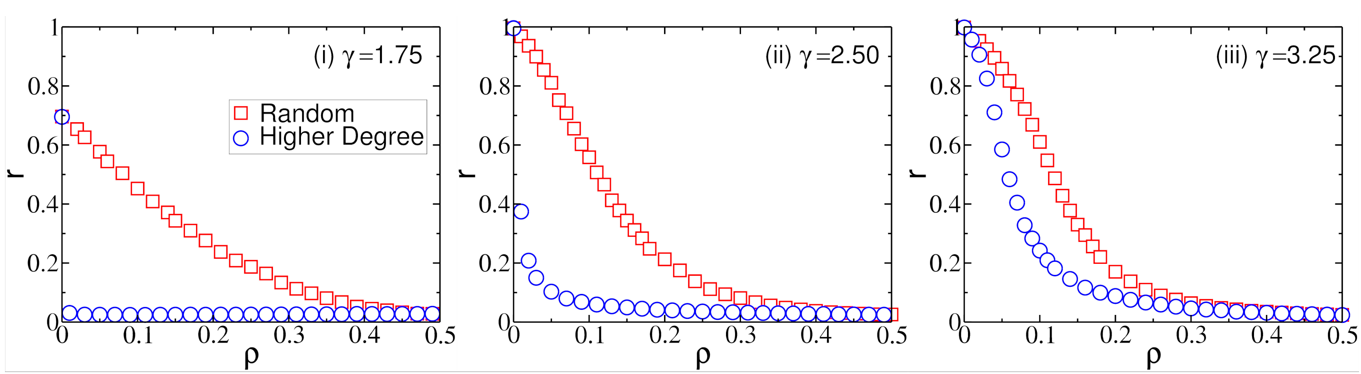

FIG. S4. **Scale-free networks with contrarians**. Fraction of pairwise contrarian oscillators assigned randomly and based on their degree to scale-free networks of different degree exponent γ, namely, 1.75, 2.5, and 3.25.