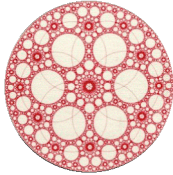


# Recycling Parrondo Games

Roberto Artuso<sup>1</sup>, Lucia Cavallasca<sup>1</sup>, Giampaolo Cristadoro<sup>2</sup>  
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<sup>1</sup>Center for Nonlinear and Complex Systems  
Universita' dell'Insubria, Como (Italy)

<sup>2</sup>Max Planck Institute for Physics of Complex Systems  
Dresden (Germany)

## Abstract

Directed transport has received a remarkable attention for a number of years now, since it has been recognized as a crucial issue in a number of physical and biological contexts. A striking phenomenon in this context is *ratchets* behavior, where currents may flow in a counter intuitive direction. Parrondo games offer a remarkable and simple illustration of these subtle transport properties: a random combination of two losing games may result in a winning strategy.

We present a deterministic analogue of Parrondo games, in the form of a (piecewise linear), periodic map on the real line, and study transport properties by means of periodic orbit expansions: in this simple setting they allow to perform analytic evaluations of the relevant quantities, while providing a highly effective perturbative technique to get accurate estimates in more general cases (for instance by considering nonlinear mappings).

We construct a deterministic realization of Parrondo games in the form of a one-dimensional mapping on the real line, we briefly review how to study transport properties of deterministic systems by periodic orbits expansions, we apply such a theory to Parrondo mappings and discuss some features of our findings, we give our conclusions, and possible future developments of the present work.