Congestion Games with Shifted Latency Functions

Karsten Tiemann
Joint work with Igal Milchtaich and Burkhard Monien
Univeristät Paderborn

Abstract

In the talk I will consider scheduling games and co-called congestion games - a more general class of resource sharing problems that can be used to model routing scenarios. We allow that for one resource different players use different latency functions. If you take the latency function of one player for an edge (e.g. $x^2 + 3$) than all other players use shifted functions for this edge (e.g., $x^2 + 1,\ x^2 + 7, \ldots$). Thus we are considering congestion games with shifted latency functions. We consider whether Nash equilibria do exist for these games, whether sequential improving steps of players can be used to reach one (finite improvement property), and whether sequential improving steps to the best strategy can be used to reach one (finite best-reply property).

Our findings are as follows:

- Games with unweighted players:
  1. We show that every unweighted congestion game with shifted latency functions possesses the finite improvement property and thus also a pure Nash equilibrium.
  2. We prove that it is PLS-complete to find a pure Nash equilibrium for an unweighted symmetric network congestion game with shifted latency functions.
- Games with weighted players:
  1. We show that every weighted congestion game with linear shifted latency functions possesses the finite improvement property.
  2. We prove that there is a weighted congestion game with non-linear shifted latency functions on parallel links that does not possess the finite best-reply property.