Cooperation in Dynamic Multicriteria Games

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Abstract. We consider a dynamic, discrete-time, game model where the players use a common resource and have different criteria to optimize. New approaches to construct noncooperative and cooperative equlibria in dynamic multicriteria games are constructed.

Keywords: dynamic multicriteria games, Nash bargaining solution.

Consider a bicriteria dynamic game with two participants in discrete time. The players exploit a common resource and both wish to optimize two different criteria. The state dynamics is in the form

$$x_{t+1} = f(x_t, u_{1t}, u_{2t}), \quad x_0 = x, \tag{1}$$

where $x_t \geq 0$ is the resource size at time $t \geq 0$ and $u_{it} \in U_i$ denotes the strategy of player i at time $t \geq 0$, $i = 1, 2$.
The payoff functions of the players over the infinite time horizon are defined by

$$J_1 = \begin{pmatrix} J_1^1 = \sum\limits_{t=0}^{\infty} \delta^t g_1^1(u_{1t}, u_{2t}) \\ J_1^2 = \sum\limits_{t=0}^{\infty} \delta^t g_1^2(u_{1t}, u_{2t}) \end{pmatrix}, \; J_2 = \begin{pmatrix} J_2^1 = \sum\limits_{t=0}^{\infty} \delta^t g_2^1(u_{1t}, u_{2t}) \\ J_2^2 = \sum\limits_{t=0}^{\infty} \delta^t g_2^2(u_{1t}, u_{2t}) \end{pmatrix}, \tag{2}$$

where $g_i^j(u_{1t}, u_{2t}) \geq 0$ gives the instantaneous utility, $i, j = 1, 2$, and $\delta \in (0, 1)$ denotes a common discount factor.

First, we construct a multicriteria Nash equilibrium using the approach presented in [2]. Then, we find a multicriteria coopearative equilibrium as a solution of a Nash bargaining scheme with the multicriteria Nash equilibrium playing the role of status quo points.

References

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