Pursuit games with costly information two approaches

Pierre Bernhard, Jean Marie Nicolas**, Odile Pourtallier**

*INRIA, Sophia Antipolis
2004, Route des Lucioles
06565 Valbonne Cedex (France)

** Thomson Sintra Activité Sous Marines
1, avenue Aristide Briand
94117 Arcueil Cedex (France)

This paper is devoted to an adaptation of pursuit game theory to a specific situation : the pursuer suffers some penalisation law when he wants to obtain information about the position of the evader, and the evader remains blind except when the pursuer takes information. Indeed, in realistic operational situations, the acquisition of information can either take some time, or may provide interesting informations to the evader, and it is why we want to approach this crucial problem by the simplified one of the present paper. In our model, we will assume that, at the beginning of the game, both the evader and the pursuer know exactly their respective positions, but they remain blind until the pursuer stops in order to acquire the new position of his opponent, this acquisition taking a given time. The game will end when the evader will be inside a given area around the pursuer.

We propose two ways in order to provide a solution to this problem.

The first one is based on the discrete game approach we proposed at Helsinki in 1989 [LNB90]. In this formalism, we demonstrate it is possible firstly to introduce a penalisation delay in the control laws, and secondly, it is possible to derive a relationship between the game aiming at the minimization of the pursuit duration and the game aiming at the minimization of the number of measures. By this way, we can elaborate specific charts computed with the algorithm of [LNB90] and devoted to our problem.

The second way is based upon the article of P.Bernhard and G.Tomski, [BT82]. The game is played with stages. For each stage the pursuer uses an open loop strategy. We define the set C_1 as beeing the set of all the initial states that lead to a capture in one stage whatever the evader does. C_1 is then considered as a the target for the second stage. Therefore we can compute a sequence of sets C_n, where C_n is the set of all the initial states that lead to a capture in at most n stages, and whatever the evader does.

With the dynamics used, we find the condition on the target that makes all the initial states capturable. We prove that the two aims : "to minimize the pursuit duration" or "to minimize the number of stages", lead to the same pursuer strategy.

References

[BT82] P.Bernhard and G.Tomski. "Une construction rétrograde dans les jeux différentiels qualitatifs, et application à la régulation". *RAIRO, (J 16):pp71-84, 1982.*

[LNB90] VV.Laporte, JM.Nicolas and P.Bernhard. "About the resolution of discrete pursuit games and its applications to naval warfare". In *Proc. 4th Symposium on differential Games and applications, 1990.*