# Abstract form

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| **Subject: Game Optimal Support Time of a Medium Range Air-to-Air Missile** |
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Abstract: (Max 100 words)


The paper formulates a support time game arising in one-on-one air combat with medium range air-to-air missiles. The guidance of such a missile typically consists of three phases: the support, extrapolation, and active phase. In the first phase, target information is provided to the missile via an uplink from the launching aircraft. After a certain support time, the aircraft evades and breaks the uplink. The break usually occurs before the missile's radar can lock on to the target, and the missile has to extrapolate the position of the target. The phase continues until the missile is able to lock on to the target, after which the missile's radar is active.

Prolonging the support phase shortens the extrapolation phase, which increases the probability of hit of the missile. On the other hand, prolonging the support phase decreases the probability of survival against a missile launched by the adversary, since the maneuvering of the supporting aircraft is limited by the gimbal limit of its radar. Thus, the pilot should maximize two conflicting goals, the probability of his or her own survival and the probability of hit, that both also depend on the support time of the adversary's missile.

In this paper, it is assumed that for given aircraft and missiles, the aforementioned probabilities depend on the duration of the extrapolation phase as well as on the maximal closing velocity the missile can achieve against its target. The maximal closing velocity as a function of the target's support time is obtained by solving a set of optimal control problems. The goals of a single pilot are transformed into the payoff function of the support time game by multiplying the probabilities of own survival and hit to the adversary. Since the pilots maximize their own, mutually conflicting payoff functions, a static non-zero-sum game results. Game optimal support times are obtained by solving a Nash equilibrium solution of the game. The constructed game model is illustrated by a numerical example. As far as the authors know, the game formulation presented in the paper is the first attempt to model the support time problem that is a crucial part in a modern medium range air combat.