

REVIEW: TAC 15-1276.1

“MULTIPLAYER REACH-AVOID GAMES VIA PAIRWISE OUTCOMES” BY
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Summary: This paper addresses the problem of finding conservative solutions for reach-avoid games, i.e., strategic interactions between two opposing teams of vehicles, where the first team tries to defend a specified zone, while the second team tries to invade this zone. Briefly, and as stated by the authors, the main contribution of this paper (compared to prior work), lies on the fact that no strong assumptions are made about the prediction models or strategies of either team. In this paper a conservative approach is presented that provides conditions under which a defender may intercept the attacker. The paper, and the methodology presented for addressing the reach-avoid games, can be structured as follows:

- First, the paper presents the definition of the reach-avoid games, considering a specific class of dynamics for the members of each team.
- Second the paper presents a definition on a strongly-defendable path and provides conditions under which a path is strongly defendable, i.e., where the defender should be so that a path is defendable.
- Based on the derivation of the one-to-one path-defense game, an algorithm for addressing the same question is presented that is based on pairwise matchings.

Comments: This is the first revision of this paper. The authors have modified the paper by removing the HJI derivation of the optimal solution and have now focused more on the path-defense problem and the conditions under which a path is strongly defendable. I would have expected though a more detailed response to the previous comments, since it would have helped the reviewing process. Nevertheless, there are several important concerns about the contribution of the paper. There are also several presentation issues (especially in Section IV.B) but at this point are less important compared to the concerns regarding the contribution.

In particular, my concerns are the following:

- (1) The results provided in this paper (Lemmas 1,2), address the question of “*whether the defender can intercept the attacker?*” and not the question of “*how the defender will intercept the attacker?*.” In other words, after reading this paper, someone that has to implement it has to find a way to derive the specific policies that a defender needs to apply. So, still the important question remains unanswered. I understand that the problem is rather difficult to be addressed, however we need something more than a conservative derivation of whether the defender can intercept the attackers.

- (2) Although this is an approach to multi-player reach-avoid games, it does not exploit the potential of a collaborative action against a set of attackers. Conservative solutions can always be defined, however the great difficulty is to go beyond that.
- (3) The path-defense methodology proposed is not reach enough to address both the problem of defense and the problem of attack.
- (4) Is it necessary that the same number of attackers and defenders is considered? From a practical perspective, such assumption is not acceptable, however from the derivation is obvious that it is not needed. In either case, this assumption is an indication that there is no much concern over the implementation-side of this work.