An issue with learning effective policies in multi-agent adversarial games is that the size of the search space can be prohibitively large when the actions of both teammates and opponents are considered simultaneously. Opponent modeling, predicting an opponent's actions in advance of execution, is one approach for selecting actions in adversarial settings, but it is often performed in an ad hoc way.

In this dissertation, we introduce several methods for using opponent modeling, in the form of predictions about the players' physical movements, to learn team policies. To explore the problem of decision-making in multi-agent adversarial scenarios, we use our approach for both offline play generation and real-time team response in the Rush 2008 American football simulator. Simultaneously predicting the movement trajectories, future reward, and play strategies of multiple players in real-time is a daunting task but we illustrate how it is possible to divide and conquer this problem with an assortment of data-driven models. By leveraging spatio-temporal traces of player movements, we learn discriminative models of defensive play for opponent modeling. With the reward information from previous play matchups, we use a modified version of UCT (Upper Confidence Bounds applied to Trees) to create new offensive plays and to learn play repairs to counter predicted opponent actions.

In team games, players must coordinate effectively to accomplish tasks while foiling their opponents either in a preplanned or emergent manner. An effective team policy must generate the necessary coordination, yet considering all possibilities for creating coordinating subgroups is computationally infeasible. Automatically identifying and preserving the coordination between key subgroups of teammates can make search more productive by pruning policies that disrupt these relationships. We demonstrate that combining opponent modeling with automatic subgroup identification can be used to create team policies with a higher average yardage than either the baseline game or domain-specific heuristics.

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The public is welcome to attend.