Disney Research automates analysis of field hockey team behaviors

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Investigators at Disney Research, Pittsburgh, have developed an automated technique for analyzing the patterns of play of field hockey teams, providing a new tool for coaches and commentators who must make sense of mountains of video and other game data.

Because players constantly change roles during the flow of play – a left winger switching temporarily with a right winger, or vice versa – the researchers found that focusing on player roles, rather than the identity of an individual, was best for detecting the tactics, strategy and style of play for each team. The video tracking data that the algorithm used as input contained errors but the modeling technique was effective in correcting many of the tracking or detection errors.

The researchers evaluated their methods using high-definition video of portions of three games recorded by eight fixed cameras. Findings of the study will be presented at the IEEE Conference on Computer Vision and Pattern Recognition, June 25-27, in Portland, Ore.

Patrick Lucey, a Disney researcher who specializes in automatically measuring human behavior, said the automated method developed for field hockey is applicable to virtually any team sport involving continuous play, including basketball, ice hockey and soccer. It could streamline the process of video analysis for coaches and their staff, providing an overview of tendencies and behaviors that would allow the coaching staff to focus on the most consequential plays and players.

Star players obviously can have considerable impact on a match, Lucey acknowledged, but the focus on player roles rather than individual identities still makes sense. "It's like when we watch a game on TV," he explained. "A lot of the time, we may not be able to identify a player, but we know where he should be based on the other players."

Demand for such automated methods has increased because of the data-driven, quantitative techniques that many professional sports teams now use to analyze performance. "We have a rich source of data, so what do we do with it? How do we make comparisons?" Lucey said. Though coaching staffs can manually quantify performance, computers have an advantage because they can compare many more teams and analyze many more matches – a whole season's worth or even multiple seasons, he noted.

A coach might use such a system to evaluate how a future opponent performed when playing a team with a similar style to the coach's own team, or to identify weaknesses in the team's play that appear repeatedly over the course of a season.

Sports events unfold over both space and time, so the research team used what's called a bilinear spatiotemporal basis model to represent play. This method of modeling dynamic objects – in this case, players and their opponents – was developed by Disney Research, Pittsburgh, and their collaborators, and simultaneously takes space and time into account when creating models.

The Disney team found that the spatiotemporal modeling approach was effective in representing role play during a match. It also helped compensate for the errors that tend to occur in computer vision systems – failure to detect some players, or falsely detecting a "phantom" player. People normally have to spend time eliminating this "noise" in the data, but the spatiotemporal modeling approach proved effective in making

these corrections.

The researchers compared their automated "de-noised" data with human-annotated game play data and found only small differences between the two. In assignments of player roles, the researchers found that their system did a good job of identifying the roles of forwards and of defenders, though the system did get confused at midfield because of the frequency with which players change position in that region of the field.

In addition to being an assistive tool for coaches and their staff, automated analysis also could be a boon to television commentators faced with an increasing amount of data and presenting reports on an increasing number of digital platforms, Lucey said.

In addition to Lucey, the research team included Peter Carr and Iain Matthews of Disney Research, Pittsburgh; Alina Bialkowski, a Disney intern and Ph.D. student at Queensland University of Technology in Brisbane, Australia; Stuart Morgan, a performance analyst at the Australian Institute of Sport, and Yaser Sheikh, assistant research professor in Carnegie Mellon's Robotics Institute.

Provided by Disney Research