

New deep learning techniques analyze athletes' decision-making

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Sports analytics is routinely used to assign values to such things as shots taken or to compare player performance, but a new automated method based on deep learning techniques - developed by researchers at Disney Research, California Institute of Technology and STATS, a supplier of sports data - will provide coaches and teams with a quicker tool to help assess defensive athletic performance in any game situation.

The innovative method analyzes detailed game data on player and ball positions to create models, or "ghosts," of how a typical player in a league or on another team would behave when an opponent is on the attack. It is then possible to visually compare what a team's players actually did during a defensive play versus what the ghost players would have done.

"With the innovation of data-driven ghosting, we can now, for the first time, scalably quantify, analyze and compare detailed defensive behavior," said Peter Carr, research scientist at Disney Research.

"Despite what skeptics might say, you can indeed measure defense."

The researchers presented their method on Mar. 3, 2017 at the MIT Sloan Sports Analytics Conference in Boston. Though they demonstrated the method using data from 100 games of a professional soccer league, they emphasize it also is applicable to other sports, such as football and basketball.

"Precise, second-by-second game data is now widely available and, as technology improves, is becoming ever more thorough," said Markus Gross, vice president at Disney Research. "As valuable as they are, metrics such as 'Wins-Above-Replacement' and 'Expected Point Value' are not the be-all and end-all of [sports analytics](#). As this new research shows, we're just beginning to realize the full potential of what the data can tell us."

Ghosting has previously been used by such teams as the NBA's Toronto Raptors, Carr noted, who developed software to predict what a defensive player should have done in particular situations instead of what he actually did. As effective as it was, this required extensive manual annotation of game data. The Disney-led team, by contrast, developed a fully automated approach using advanced machine learning techniques.

"Our approach avoids the need for manual input," Carr said. "Our ghosting model can be trained in several hours, after which it can ghost every play in real-time. Because it is fully automated, we can easily learn models for different subsets of data, such as all the games of a particular team."

The researchers used a type of machine learning called deep learning, which uses brain-inspired programs called neural networks. To learn the fine-grained behavior model for each player role in a formation, they used recurrent neural networks, a popular deep learning tool that is able to examine the recent history of player actions to make predictions of subsequent actions. Similar tools were famously used to create artificial intelligence programs that were able to master video games and beat top human players of the board game Go.

For games such as soccer, where the game state is continuous in both space and time, standard [deep learning](#) techniques were not sufficiently robust. As time progressed, the predictions tend to veer from ground

truth. To address this issue, the researchers leveraged techniques from imitation learning, a tool that is able to learn from demonstrations and has proven useful in robotic applications, said Yisong Yue, assistant professor of computing and mathematical sciences at Caltech.

Combining creativity and innovation, this research continues Disney's rich legacy of leveraging technology to enhance the tools and systems of tomorrow.

Provided by Disney Research

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