A Computer Vision Approach to Quantify Player Spacing in NBA Shooting

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Project description

Recently, many novel statistics have been introduced to narrow down the skill-level of NBA players to a single number. Furthermore, three-point shooting and spacing has become central to success in the league. However, while three-point percentage provides a good indication of a player's shooting prowess, it does not account for how tightly guarded a player is. This project proposes to use computer vision and object detection methods to develop a new metric to quantity how much a player's shooting threat attracts defenders and thus opens up space in other areas of the court.
The project will be using footage of NBA basketball games that can be found publicly on YouTube. No specific computing resources will be needed.

Models & evaluation

Player detection and label classification

The initial step of the project involves merging an object detection model with a classification model to accurately recognize players in any segment of a TV broadcast and subsequently categorize them within the NBA player pool. The approach will involve leveraging more conventional object detection models such as R-CNN initially, and then progressing towards utilizing larger pre-trained models like YOLOv8 for enhanced performance.

Geometric projection & motion estimation

Next, it will use geometric projection techniques to pinpoint players' locations on the court in each frame. This involves employing homography mapping to compare the representation of the court's boundaries in the camera feed with their actual dimensions. Additionally, it will explore tracking the movement of each player between frames to transition from static position identification to analyzing players' and ball's motion throughout the sequence.

Evaluation metrics

To evaluate whether the inferred position are correct, the project requires ground truth positions. To do so, it will use publicly available data on the locations of shots during games. As such, for every shot taken in a game, it will be possible to identify whether the models identify the correct player and position on the court.

Expected results

From the classification and detection models, the goal is to leverage the output player and ball trajectories to investigate the difference in how players are guarded on the court. This could be done by visualizing the distance to the closest defender, or the density of defenders around a player, and how these vary depending on the location of the ball and the distance to the rim. As a final goal, the project hopes that the models can be used to attach a "gravity" metric to all players, quantifying the spacing they provide and thus helping front offices understand how much players are feared as shooters in the NBA.

Relevant literature

[1] Y. Pandya, K. Nandy, and S. Agarwal, "Homography based player identification in live sports," *2023 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, pp. 5209–5218, 2023. DOI: 10.1109/CVPRW59228.2023.00549.

[2] L. Citraro, "Real-time camera pose estimation for sports fields," *Machine Vision and Applications*, 2020. DOI: https://doi.org/10.1007/s00138-020-01064-7.

[3] Y. Ohno, J. Miura, and Y. Shirai, "Tracking players and estimation of the 3d position of a ball in soccer games," *Proceedings 15th International Conference on Pattern Recognition. ICPR-2000*, pp. 145–148, 2000. DOI: 10.1109/ICPR.2000.905293.