Quantifying off-ball offensive movement in the NBA

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Abbreviated abstract: Conventional NBA stats don't reflect off-ball movement which creates space valuable for offense. This probabilistic model makes use of spatiotemporal NBA data to quantify space created by players in an offensive possession. It aims to go past shot data and get values for each instance when a player creates space to score - irrespective of whether a shot is taken. (To characterise, each backdoor cut receives a value)

Related publications:

 Physics-Based Modeling of Pass Probabilities in Soccer - W.Spearman et al, MIT Sloan Sports Analytics Conference (2017)



Problem

Challenge:

- Quantifying NBA players finding valuable space to shoot from when not in possession of the ball
- Recognising actions like curling off a screen, cutting to the basket, quick movement on the fast break etc



- In (A), Redick is wide open on the wing during a fast break - doesn't get the ball.
- In (B), he curls off a screen gets the ball in space and makes the shot.
- Both actions are offensively valuable.
- Conventional stats don't recognise (A).
- Action (B) is recognised just as a threepoint make, but the curl off the screen is not reflected in the stats.

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<u>The aim is to quantify (A),</u> (B), and other similar actions



J J Redick - LAC vs LAL, 25 Dec 2015 (Please use fullscreen for snapshots)

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Approach

Introducing Court Control:

- It is defined as the control one team has over any region of the court at any point in the game.
- Thus, it considers the probability of the ball being passed to that region and the team gaining control over it.



Court Control snapshot

Red means one team has control there, blue means the other. <u>Method</u>:

- Equations of motion solved for ball and players assuming drag coefficient.
- Uncertainty in time to control ball modelled using Logistic Distribution.
- Get derivative function of court control by doing (prob. of no other player intercepts ball)*(prob. of player X controls ball) - integral solved using Gauss-Legendre quadrature. (Inspiration: W. Spearman *et al*)

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Formula: For each frame of data when player X doesn't have the ball but his team has possession:

OB(off-ball) value of that frame for X = (court control)*(expected field goal %)*(3-pt or 2-pt shot)



Results and Conclusions

- In summary, OB value measures probability of player X receiving the ball, shooting the ball and making the shot - at any time he is on the court and his team has possession.
- Certain filters are applied on velocity and location and closest defender to make sure that **low non**zero instances of OB values are ignored.
- Expected field goal % is calculated by simple regression model on **shot location** and **closest defender**.



This snapshot contains all Redick's valuable locations in the game, size of markers indicates the OB value.

From slide 2 – OB Value of (A) = 1.7, OB Value of (B) = 1.53

Redick gets a total OB value of **41.14 from 45 valuable actions**. This total and value per action can be measured across the league to compare off-ball movement - especially for wing players who don't handle the ball much.

Data used: SportVU NBA tracking data from the 2015-16 season publicly available on GitHub.



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