

# Motion capture reveals why VAR in football struggles with offside decisions

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New research by the University of Bath has used motion capture technology to assess the accuracy of Video Assistant Referee (VAR) technologies in football. The study suggests that VAR is useful for preventing obvious mistakes but is currently not precise enough to give accurate judgements every time.

VAR was introduced into association football in 2018 to help referees review decisions for goals, red cards, penalties and offsides. The technology uses film footage from pitch-side cameras, meaning that VAR operators can view the action from different angles and then offer their judgements on incidents to the head referee to make a final decision.

However, the accuracy and application of VAR has also been questioned by some, including high profile pundits like Gary Lineker and Alan Shearer, following controversial decisions which can change the course of the game.

Critics of VAR further argue that it hampers the flow of the game, however some research suggests it has reduced the number of fouls, offsides and yellow cards.

Dr. Pooya Soltani, from the University of Bath's Centre for Analysis of Motion, Entertainment Research and Applications (CAMERA), used optical motion capture systems to assess the accuracy of VAR systems.

He filmed a [football player](#) receiving the [ball](#) from a teammate, viewed from different [camera](#) angles, whilst recording the 3D positions of the ball and players using optical motion capture cameras.

Participants viewing the clips were asked to determine the exact moment of the kick and judge whether the ball receiver was in offside.

The study found that, on average, the participants thought the ball was kicked 132 milliseconds later it actually was, as measured by the optical motion cameras. It also found that participants were more accurate in their judgements when the action was viewed at 0 and 90° angles, and when VAR guiding lines were present.

Dr. Soltani says that "VAR is really useful in helping referees make accurate decisions, but this study has shown it has definite limitations."

"The frame-rate and resolution of the cameras used in VAR sometimes does not keep pace with the fast movements, meaning that sometimes the player or the ball is blurred."

"So, the viewer has to use their own judgment to extrapolate where the players were at the moment the ball was kicked, which affects whether it is offside or not."

"My research found that the ball was kicked 132 milliseconds earlier than the participants perceived, which doesn't sound like much, but in a fast-paced game it could be long enough for the players to be in a different location and therefore could potentially change the outcomes of offside."

"This goes to show that whilst VAR is useful to spot obvious errors, it shouldn't be relied upon completely to make referee decisions."

The study suggested that the accuracy of VAR could be improved by using higher frame-rate cameras that would record the movement of the ball in slower motion. Also, for marginal offside decisions, thicker guiding lines in the VAR could be used to represent the uncertainty zone.

The accuracy could also be improved by viewing the gameplay from multiple angles.

Dr. Soltani says that "using higher resolution, faster frame-rate cameras, and volumetric [motion](#) capture approaches would improve the accuracy of VAR, but would be a lot more expensive."

"Whether right or wrong, I think the referee's final decision adds flavor

to the game."

Dr. Soltani's research also featured in a recent Images of Research 2022 exhibition at the University of Bath, where it was highly commended in the digital category.

Pooya Soltani (2022) "Is perception of VAR outcome biomechanically accurate?" will be presented at 40th Conference of the International Society of Biomechanics in Sports (ISBS) on 20 July 2022.

**More information:** Conference: [www.isbs2022.org/](http://www.isbs2022.org/)

Provided by University of Bath

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