
Sports

How an Astrophysicist Used Math to Take the Math out of Darts

A new pub chain is looking to make darts more accessible to younger people by creating automatic scoring technology. It's harder than you think.



By [B. David Zarley](#)




June 26, 2018, 5:42pm   



IMAGE VIA [FLIGHT CLUB](#)

On a rainy early afternoon in Devon, in South West England, Steve Moore and Paul Barham dropped in on a pub and came across a group of darts players, something in and of itself not too unusual, except for the player's make up. As twenty-somethings, they were younger than the average pub player, and evenly split between men and women.

Since the game's heyday in the 1970s and 80s, when it drew TV audiences and plenty of popular attention, darts had settled back down into pub entertainment, in the common conception mainly enjoyed by drunken older men. Seeing the fun this young

group of players was having, Moore and Barham were inspired to bring darts back as a social experience, a night out for friends.

Moore, who had spent a decade trading futures, quit his job and began workshopping a way to streamline the darts experience and make it more approachable for the uninitiated. Moore and Barham had their work cut out for them, though. The way they saw it, the complications of scoring—so often done by hand on a chalkboard—and knowing the rules were keeping young people away from darts. Introducing tech to the equation could solve this problem, but also presented new ones: the physical barriers of having the power and precision to stick the dart for an accurate score or to trigger a pressure board, and determining exactly where on a board the dart landed would be issues.

They needed a technological framework that could solve these problems, with the most complicated being the tracking for automatic scoring. Similar systems already exist, most famously the Hawk-Eye, which tracks balls for tennis and soccer, among other sports. But tracking a ball was one thing; tracking darts was considered quite another.

“The working assumption in the industry, or everywhere, was it just wasn't possible,” Moore said via phone.

Computer vision systems utilize cameras and complex mathematical models to pinpoint where in three dimensional space an object is located. A ball is a fairly simple object, the same shape from the viewpoint of any camera looking at it; a goal line or baseline is a fairly simple demarcation. Darts, on the other hand, come at the board from a dizzying array of angles, any of which would cause the dart to appear as a different shape to a camera; furthering the confusion, players, especially elite ones, often cluster their shots together, practically on top of one another.

“You have to do a lot of forecasting tools,” Moore said. “It's just so over-engineered; the mathematics behind it is pointlessly silly, but it's needed.”

Moore put out a challenge to universities and PhD programs across the U.K. and Europe: under the guise of archery, design a forecasting system that could track missiles with the speed and accuracy an automatically scored dart board would need.

Dr. Jason Dale, an astrophysicist with a computer vision PhD, answered the call. Dale had previously worked on projects for NASA and the Defense Advanced Research Projects Agency (DARPA), a division of the United States Department of Defense that designs experimental technologies, and his aerospace background made him uniquely suited to working out how to track arrows or darts.

“I guess I worked in a similar industry in that it involved pointy things flying through the air,” Dale said by phone.

The final, refined product, made with the help of countless product testing, relies on three high performance cameras mounted above a classic Unicorn dart board—their desire to keep the iconic board unchanged ruled out a more accurate pressure plate scoring system common in bars in the U.S.—operating Dale's mathematical model.

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The overlapping flight paths are the most difficult aspect to model. Darts in a specific shade of blue—they've chosen something close to ultramarine; any color would have worked—are tracked by the three cameras when thrown. The math relies on brute force to track the darts; it rapidly throws three virtual darts through millions of different orientations and angles until it finds what matches where the dart landed on the board.

“It makes billions of operations,” Dale said. “Essentially, millions of different dart hits are attempted until it finds which one fits all three crossing darts on the image.”

A simple touchscreen interface and video screens add the bells and whistles, and the whole thing—dubbed an “oche”—are the key element of Flight Club, the “social darts” bar and restaurant chain making its first inroads into the U.S. in Chicago. Players input names and photos, and the oche takes them through a variety of unique, Flight Club-specific darts games.

Since its first jury-rigged setup in Moore's shed, when the oche system took 16 seconds to compute an incorrect result, Dale says they can now accurately track three darts with 99.6 percent accuracy, computing where they land on the board within 200

microns of accuracy and in less than half a second. The system seems simple and seamless while it is used, with no delay or obvious misses when VICE Sports tossed a few in Chicago.

Adam Breeden, founder of ping pong bar AceBounce and the U.S. operator of Flight Club, considers the technology the most essential part of the game.

“You're not playing darts,” Breeden said when reached by phone. “You're using a dart board, but you're actually playing something totally different.”

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