New technique will help experts make heads or tails of male fertility

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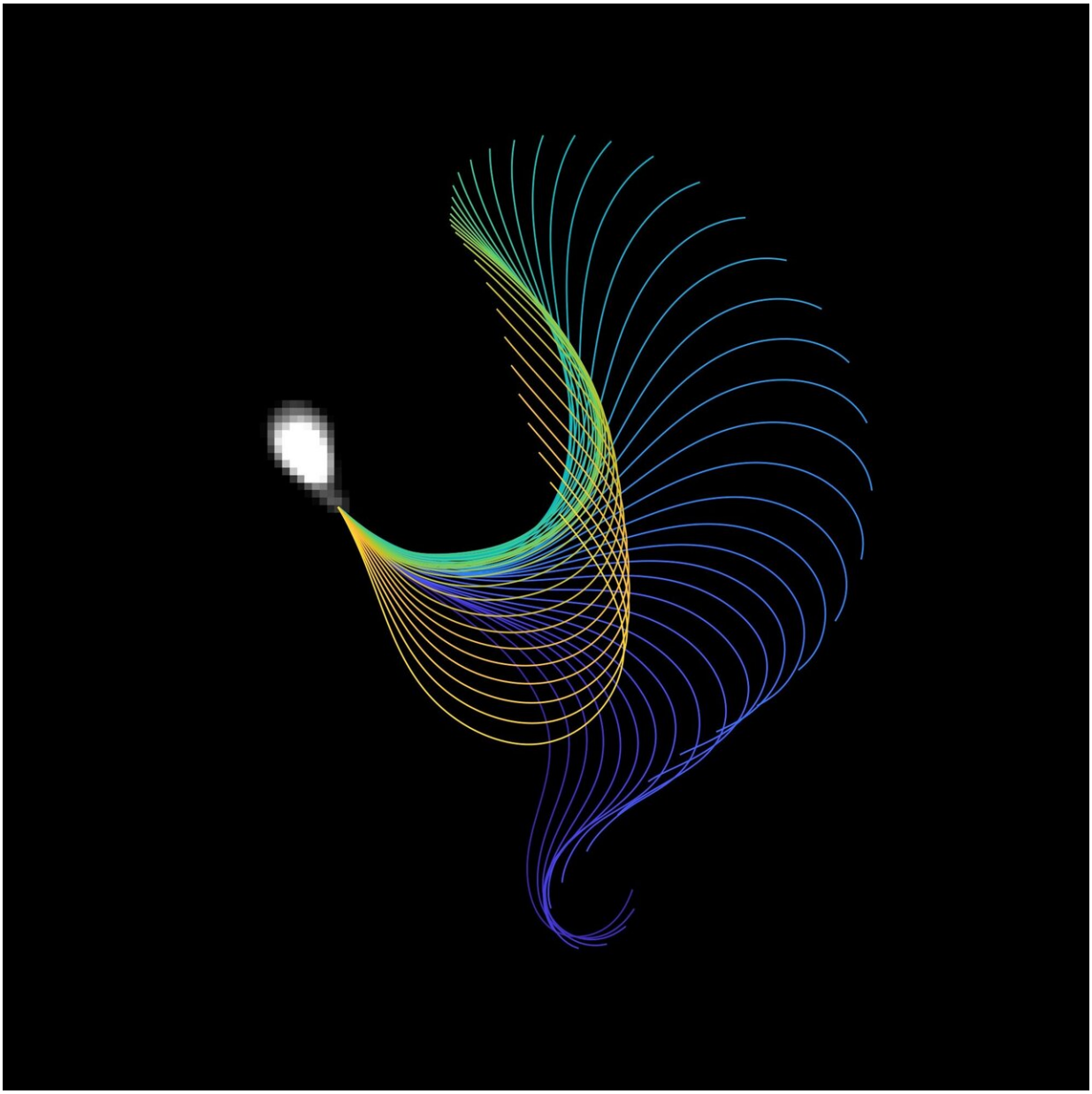

Sperm image captured with FAST (flagellar capture and sperm tracking). Credit: University of Birmingham

A new way of analysing sperm that tracks the movement of the sperm tail could enable substantial improvements to male fertility testing.

The technique measures the speed and action of the sperm flagellum, or tail, which provides vital information for understanding whether sperm in an ejaculate have the potential to reach and fertilise the egg.

It was developed by a University of Birmingham team led by Professor Dave Smith in the School of Mathematics, in partnership with the University's Centre for Human Reproductive Science and is published today in the journal *Human Reproduction*.

Professor Smith explains: "We have all heard of 'sperm count', and indeed the tools available to understand sperm—manual counting with a microscope—have not changed much since the 1950s. However, think of the amount of technology—camera, computing, connectivity—that we all now have access to. This project is about harnessing these 21st century technologies to address male fertility problems."

Current methods of analysing sperm for male fertility have been restricted to either counting the number of sperm produced, or tracking the head of the cell and there is limited understanding of what a healthy swimming sperm looks like.

Meurig Gallagher, lead author of the study, says: "Sperm have an incredibly challenging task—they must travel distances of several thousand times their own body length through the female reproductive tract in search of an egg. This journey whittles a population of many

million cells down to under a hundred. The flagellum is responsible for propulsion and navigation, so it's really vital that we understand what success looks like—how a healthy tail moves and how it consumes energy."

Using a combination of rapid, high-throughput digital imaging, mathematics and fluid dynamics to detect and track sperm in samples, the team have developed a free-to-use software package called FAST (flagellar capture and sperm tracking). They hope clinical research teams worldwide will start to use this to better understand how sperm motility relates to fertility.

This improved understanding will help researchers and clinicians develop new interventions to tackle male fertility problems.

Gemma Cupples, of the School of Mathematics, developed the system's mathematical model to understand the amount of energy required for sperm to swim effectively. "The new model enables us to measure miniscule forces that are impossible to measure experimentally," she explains. "The technique has lots of potential for other important problems, for example understanding how bacteria spread, and how fluids are transported around in tiny spaces in the body such as the brain."

Jackson Kirkman Brown MBE, of the University's Centre for Human Reproductive Science, led the clinical strategy. "Diagnostic techniques are crude and there are still no drugs available for treating male infertility," he says. "We know that sperm motility is a major factor and so being able to analyse the movement of the sperm in detail will ultimately help us to identify appropriate treatments or lifestyle changes to tackle male fertility problems, giving couples clearer answers and enabling better decisions.

"Importantly, the better diagnoses this technique should enable will mean that patients can also be better assigned the correct treatment—be that an inexpensive and 'easy' treatment such as washing the sperm and injecting into the womb, or more invasive and complex treatments such as IVF or ICSI—a process similar to IVF in which sperm is injected directly into the harvested egg."

More information: M T Gallagher et al. Rapid sperm capture: high-throughput flagellar waveform analysis, *Human Reproduction* (2019). DOI: 10.1093/humrep/dez056

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