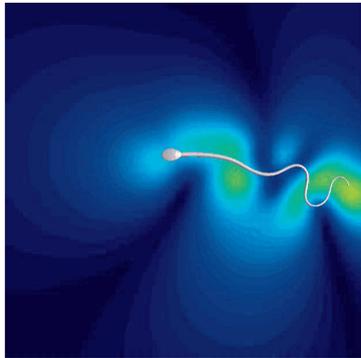


BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

Mechanics of sperm motility and fertilisation



Background

Fertility problems affect 1 in 6 couples, with male factors being present in over half of all cases. The most common problem is poor 'motility', the ability of sperm to swim to the egg and fertilise. Despite decades of research, the mechanics, forces and energy expenditures of normal and poor motility sperm are far from being fully understood. Central challenges are: 1) having the computing power to test large data sets of sperm tail beat waveforms and cell body shapes, and 2) taking into account the complex fluid properties of the reproductive tract mucus that sperm swim through, and the complex internal apparatus of the human sperm tail. For these challenges, supercomputing power is necessary.

Results

Sperm tend to accumulate near microscope slides and coverslips, and people have worked on explaining this since the early 1960s. We developed the first long-timescale simulation method to explore this behaviour, and the mechanisms involved.

Through using large numbers of parallel simulations on BlueBEAR we were able to explore the parameter space and show what tail beats result in this behaviour. The simulation capability of BlueBEAR also allowed us to discover a new symmetry-breaking phenomenon affecting the sperm tail beat, which could explain how sperm may become trapped as they migrate. These codes and methods are being used by researchers in mathematics, in the mathematical institute at Oxford University, and also by researchers in the medical school and Birmingham Women's Hospital to understand sperm swimming microscopy observations. Other problems being considered include the swimming of trypanosomes, which cause sleeping sickness, symmetry-breaking in embryo development, and drug delivery to the colon (jointly with chemical engineering).



Client Profile

Dave Smith
School of Mathematics
The University of Birmingham
Edgbaston, Birmingham,
B15 2TT, UK

Contact Details

Email : d.j.smith.2@bham.ac.uk
Tel : 0121 414 2914
web.mat.bham.ac.uk/D.Smith

Product Used

Intel Fortran compiler (serial and MPI versions)
Matlab
NAG SMP and serial libraries
ScaLapack

Funding

Medical Research Council, Science City (HEFCE funds), EPSRC

Contributors

Dr Jackson Kirkman-Brown
Prof John Blake
Dr Eamonn Gaffney
Hermes Gadelha
Dr Daniel Loghin
Tom Johnson

Affiliation : Clinical and Experimental Medicine

UNIVERSITY OF
BIRMINGHAM

For more information:

BEAR, IT Services
Elms Road Computer Centre (G5)
Edgbaston
Birmingham B15 2TT
Tel: 0121 414 5877
Email: bearinfo@contacts.bham.ac.uk
Website: www.bear.bham.ac.uk