Supercomputing for a superproblem: A computational journey into pure mathematics

November 6 2012

A world-famous mathematician responsible for solving one of the subject's most challenging problems has published his latest work as a University of Leicester research report.

This follows the visit that famed mathematician Yuri Matiyasevich made to the Department of Mathematics where he talked about his pioneering work. He visited UK by invitation of the Isaac Newton Institute for Mathematical Sciences.

In 1900, twenty-three unsolved mathematical problems, known as Hilbert's Problems, were compiled as a definitive list by mathematician David Hilbert.

A century later, the seven most important unsolved mathematical problems to date, known as the 'Millennium Problems', were listed by the Clay Mathematics Institute. Solving one of these Millennium Problems has a reward of US $1,000,000, and so far only one has been resolved, namely the famous Poincare Conjecture, which only recently was verified by G. Perelman.

Yuri Matiyasevich found a negative solution to one of Hilbert's problems. Now, he's working on the more challenging of maths problems - and the only one that appears on both lists - Riemann's zeta function hypothesis.

In his presentation at the University, Matiyasevich discussed Riemann's hypothesis, a conjecture so important and so difficult to prove that even Hilbert himself commented: "If I were to awaken after having slept for a thousand years, my first question would be: has the Riemann hypothesis been proven?"

Professor Alexander Gorban, from the University of Leicester, said: "His visit was a great event for our mathematics and computer science departments.

"Matiyasevich has now published a paper through the University that regards the zeros of Riemann Zeta Function (RZF). This is a mathematical function which has been studied for over a hundred years.

"The goal of this paper is to present numerical evidence for a new method for revealing all divisors of all natural numbers from the zeroes of the RZF. This approach required supercomputing power.

"There is previous evidence of famous pure mathematical problems using massive computations. Unfortunately, the Riemann hypothesis is not reduced to a finite problem and, therefore, the computations can disprove but cannot prove it. Computations here provide the tools for guessing and disproving the guesses only."

More information: The paper on how supercomputers have helped the mathematicians to travel into the world of the Riemann hypothesis is now available online, together with the presentation of the Matiyasevich talk, at: www2.le.ac.uk/departments/math … esearch-reports-2012

Provided by University of Leicester