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World's biggest heart model simulated

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Researchers from the Université de Montréal have used a supercomputer to conduct the largest-ever mathematical simulation of the electrical activity of a human heart – a 2 billion element model – to provide new insight into cardiac and other illnesses. Until recently, the world's largest simulated hearts had a few million elements at most. The UdeM simulation was up to 1,000 times more detailed than previous models and will enable new scientific discoveries that would never have been possible otherwise.

The computer on which the simulation was performed, a 768-processor SGI Altix 4700, is the largest shared-memory computing system in Canada. Operated by the Réseau québécois de calcul de haute performance (RQCHP), it is used by hundreds of Canadian researchers. Mark Potse and Alain Vinet, of the UdeM's Institute of Biomedical Engineering, routinely use 60 to 100 of these processors to run their simulations of the human heart. In late October, Potse and Vinet had the opportunity to use the entire SGI Altix system and its1.2TB of shared memory to solve the largest, most detailed heart model ever.

Two weeks to simulate full heartbeat

The researchers simulated five milliseconds of activation in a tissue block that included some properties of a real heart, such as fibre running in different directions. The simulation solved a system of two billion equations a dozen times. The test took two hours. A full heartbeat, Potse says, would take two weeks to simulate and his team cannot claim use of the entire supercomputer for such lengths yet. "The purpose of the test

was to show that when the next generation supercomputers becomes available, researchers will be able to use it effectively," said Vinet. "This type of model is increasingly difficult to solve when it is larger. It was far from evident that this test was going to work."

With heart disease one of the leading causes of death in the Western world, discovering the electrical triggers of the various kinds of heart disease could lead to earlier diagnosis and new treatment breakthroughs. In order to understand what the mechanisms of the particular disease are, the heart must be modeled with enormous detail. Once disease mechanisms are fully understood, scientists will be able to devise the best drug or the best cure — surgical or other remedies -- and doctors will be able to diagnose much more precisely. Without the use of computer models it can be hard to track the effects of a heart disease on the ECG.

Source: University of Montreal