3-D Model Of Blood Flow By Supercomputer Predicts Heart Attacks

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EPFL Laboratory of Multiscale Modeling of Materials, in Switzerland, has developed a flowing 3D model of the cardiovascular system that should allow for predictions of certain heart diseases before they become dangerous.
The supercomputer Cadmos, installed at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in August of 2009, has bared one of its first fruits: the Laboratory of Multiscale
Modeling of Materials has recently developed a computer program the accurately models the complex system of blood flow in the heart for individuals at an unheard-of precision of ten millionths of a meter or ten microns. These individual-specific models-which take up to six hours using a supercomputer-will allow for a detailed study of the cardiovascular system and lead to early predictions of heart conditions such as arteriosclerosis, or the hardening of arteries that often leads to heart attacks. Plans are in the works to develop the program for individual PCs for clinical applications within the next two to three years.

"When studying the blood flow in arteries, one has to take into account a vast number of different fluid interactions that happen on different time scales and of different sizes," explains Simone Melchionna, who heads the project. Based on a detailed heart scan, the simulation juggles over a billion different variables in order to represent a fluid containing ten-million red blood cells. Using another supercomputer based in Juelich (Germany), the research team has achieved even greater precision with their program that allows for the visualization of the interaction of plasma, red blood cells and even micro-particles. "We can evaluate all of the elements and how they interact with each other; move, stagnate and whirl and turn over each other," Melchionna adds.

This precision will allow for the detection of the first signs of arteriosclerosis when the plaques begin to form on the artery's walls and disturb blood flow. This condition, which creates dangerous rigidity and blockage of these vital vessels, is the main cause of heart attacks-responsible for 12% of deaths in the world. This mortality rate increases to 16% in richer countries, where greasy and cholesterol rich foods are more common. Early detection of the forces leading to arteriosclerosis is one element in the strategy developed by EPFL and the universities of Geneva and Lausanne to rationalize the investment in a supercomputer of 16,000 microprocessors-the equivalent of 8,000 PCs.

SOURCE [2]

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