Researchers have created a breakthrough model biological supercomputer

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Researchers from the EU-funded ABACUS project have created a model biological supercomputer that is both sustainable and highly energy efficient.

The model bio-supercomputer is powered by adenosine triphosphate (ATP), the substance that provides energy to all of the cells in a human body. The model is able to process information extremely quickly and accurately using parallel networks, in the same fashion that electronic supercomputers are able to process information.

However, the bio-supercomputer developed by the project team is much smaller and more energy efficient than the current generation of electronic supercomputers, being only the size of a standard-sized book.

The model bio-supercomputer was created with a combination of geometrical modelling and engineering expertise on the nano-scale. Importantly, it is the first step in showing that a biological supercomputer could realistically work in practice.

Small, portable and energy efficient

The circuit created by the researchers is around 1.5 cm square and instead of electrons being propelled by an electrical charge, as is the case with a traditional microchip, short strings of proteins (called 'biological agents' by the project team) travel around the circuit in a controlled way.

These movements are powered by ATP, a biochemical that enables internal energy transfer among cells.

Traditional supercomputers use a large amount of electricity and thus heat up to such high temperatures that they need to be physically cooled in order to function effectively. To do this, many supercomputers often require their own dedicated power plant.

In contrast, due to being run by biological agents, the bio-supercomputer hardly heats up at all and is consequently much more sustainable and cost-effective. As the technology is developed further over the coming years and possible routes to larger-scale commercialisation are considered, this could become a major selling-point.

Calculating answers to major societal issues

Although the model bio-supercomputer has successfully and efficiently tackled a complex mathematical problem by using parallel computing in the same fashion as traditional supercomputers, the project team recognises that there is still a long way to go between the model and the development of a full-scale functional bio-supercomputer.

It is hoped that an eventual shift to bio-supercomputers will provide solutions to the growing problem of traditional supercomputers being increasingly unable to quickly calculate answers to some of society's most pressing issues, such as the development of new drugs and ensuring that engineering systems work as they are supposed to. For these problems, computers have to simply go through all of the possible guesses before reaching the correct answer. This means that if the problem size increases even modestly, the computer can no longer solve it quickly enough to be useful.

Next steps: From science fiction to science

The project team has already begun to explore other avenues on how to push their research even further, and hope that other scientists will be encouraged to also construct new models using alternative biological materials.

The eventual goal would be to perfect the design for a new generation of smaller, more portable and more energy efficient bio-supercomputers that can fully replace traditional supercomputers.

Although the research team believes that it will still take some time for this to become a reality, a potential mid-term solution would be to produce a hybrid design, mixing traditional and biological technologies.

The ABACUS project, which received over EUR 1, 725, 000 of EU funding, is coordinated by Lunds University in Sweden, but the research that led to the creation of the model was spearheaded by a team at McGill University in Montreal, Canada, one of the ABACUS consortium members.

More information: For more information please see ABACUS project website: abacus4eu.com/

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