Quantum Computer Science on the Internet

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A simulated quantum computer went online on the Internet last month. With the ability to control **31 quantum bits**, it is the most powerful of its type in the world. Software engineers can use it to test algorithms that might one day be applied in real computer networks.

Many computing problems in fundamental physics or mathematics require huge amounts of processing power – far more than present-day computers are capable of providing. A well-known example is the prime factoring of very large numbers: Computer scientists use this technique to measure computer performance, and apply them for advanced encryption systems. Quantum computers, based on the laws of quantum physics, would be much more efficient at solving such complex problems than today's "ordinary" computers. Unlike classical binary digits (0 or 1), their smallest units of information can assume any value between 0 and 1. This could permit massively parallel computation and multiplies storage capacity by a factor of many billions.

But quantum computers are still at a very early stage of development. The hardware requirements are extremely demanding and the few existing quantum computing devices only have a limited processing capacity of at best 7 qubits (27 = 128 bits processing size).

Since mid-June, a research group at the Fraunhofer Institute for Computer Architecture and Software Technology FIRST has been offering Internet access to the world's most powerful (31 qubit) quantum simulator, at www.qc.fraunhofer.de. Using a standard browser, interested parties in research and industry can see how quantum waves and atomic particles are used to process information, and thus gain a better understanding of how quantum processes work. The demonstration area of the site contains examples of several standard problems. Users can set up their own new algorithms and logical operations after registering online (free of charge). The simulator demonstrates the way in which a quantum computer would go about solving the calculation. Is the newly developed algorithm suitable for quantum computing, and does it achieve the desired result?

"The main focus of our project lies in the simulation of Hamiltonians, i.e. the experimental implementation of quantum algorithms," emphasizes Helge Rosé. "This will give us a better understanding of the differences between real and theoretically ideal quantum computing devices." It is also a means of gathering knowledge that will later be needed to build real quantum computers. "Members of the quantum computing community have no need to wait for the next generation of quantum computers – they can test their developments and ideas today," the project manager concludes.

Source: Fraunhofer-Gesellschaft