Researchers strive to simulate turbulent combustion in aerospace applications

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A research team at the University of Pittsburgh is developing quantum-computing algorithms to better model turbulent combustion in aerospace applications.

A five-year U.S. Air Force grant was awarded this month to principal investigator Peyman Givi, the James T. MacLeod Professor in the Swanson School of Engineering, who is working with faculty members from Pitt's Kenneth P. Dietrich School of Arts and Sciences and Center for Simulation and Modeling.

"Most people think of turbulence as unsettling or chaotic because of their experiences on planes," said Givi. "But when it comes to engines, the hope is to make it as turbulent as possible. It's like putting cream in your coffee. The more you mix it, the better it'll taste or perform."

The impetus for the Pitt team's research is centered on the fact that despite its emergence more that two decades ago, quantum computing based on quantum mechanics hasn't been used in aerospace applications, said Givi. Because the nondeterministic nature of Givi's classical equations for turbulence, the Pitt research team—Pitt physics and astronomy professors Andrew Daley and Jeremy Levy and the Center for Simulation and Modeling research professor S. Levent Yilmaz—thought there might be a way to solve the equations on quantum computers, rapidly speeding up the process of modeling turbulent combustion.

"We've developed equations that can model turbulent combustion very accurately, and we've been successful in solving them on today's classical computers," said Givi. "Now, with the help of this grant, we will formulate these equations in such a way that they can be solved on quantum computers."

Because quantum computers have yet to be actualized, Daley and Levy will be looking at different concepts on how one might go about building quantum computers so the researchers can make hardware that acts like a quantum machine. And even though Einstein himself advised scientists to avoid the unsolved field of turbulence, the team is hoping the use of quantum computing will make great strides toward solving the problem.

"If some of the things we are thinking do work and eventually we do achieve this, a process that could take weeks or months will transpire in minutes," said Givi. "It really is a quantum leap."

Provided by University of Pittsburgh