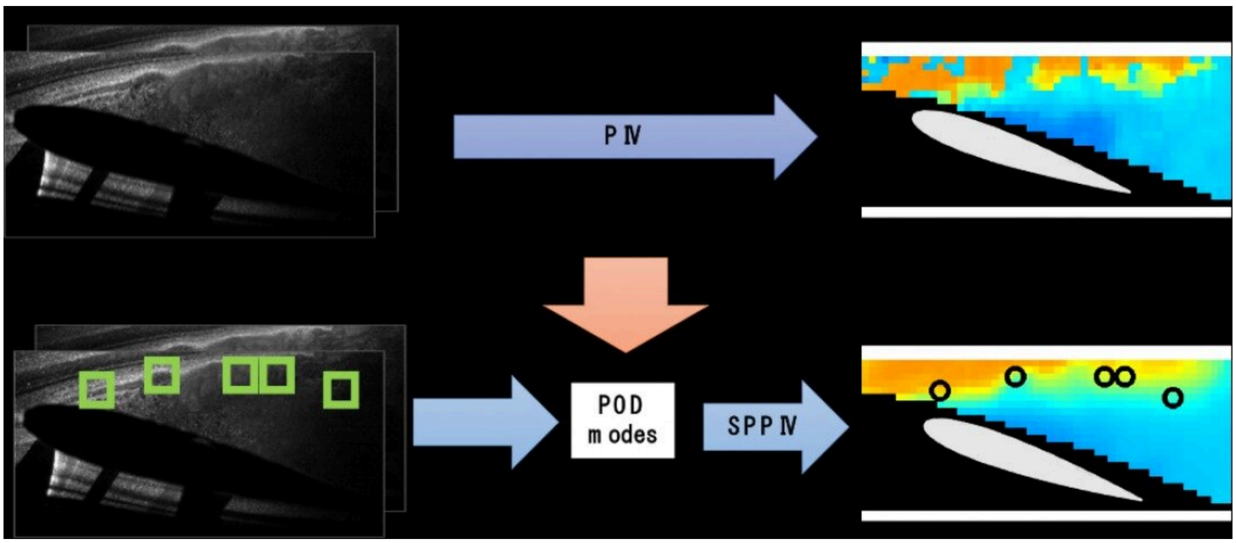
Real-time measurement of high-speed airflow is 20 times faster than conventional methods

September 15 2022



A graphical image of PIV and SPPIV. Credit: Tohoku University

A research group has developed, and now successfully tested, a new method to measure fluid flow velocities. Sparse processing particle image velocimetry (SPPIV) optimizes conventional measurement ways, and has succeeded in calculating real-time, high-speed fluid flow.

Details of the group's findings were published in the journal *Experiments in Fluids* on August 29, 2022.

Measuring the velocity field of a fluid flow, such as air or water, allows for greater feedback and control. This is becoming important in the push to boost the performance and fuel-efficiency of aircraft.

Particle image velocimetry (PIV) has traditionally been used to measure fluid velocity.

PIV employs image correlation analysis to determine a fluid's movement. Whilst this provides two-dimensional data and renders installing sensors unnecessary, processing the large amounts of data is time-consuming, especially with images of high-speed airflow. Because of this, real-time measurements are impossible with PIV.

Associate Professor Taku Nonomura from Tohoku University's Graduate School of Engineering and Research Fellow Kumi Nakai from the National Institute of Advanced Industrial Science and Technology's Research Institute for Energy Conservation have been leading a group to overcome PIV's shortfalls.

SPPIV harnesses a low-dimensional mode and sensor position optimization technology. The low-dimensional mode narrows the complex phenomenon to broader features, weeding out nonessential information that convolutes data calculation. The sensor position optimization technology carefully selects the optimal observational points, instead of flooding systems like PIV does.

Fabricating a wind tunnel experiment with a real-time, high-speed camera, the group demonstrated that real-time measurement is possible using SPPIV. They also witnessed the world's first real-time measurement of fluid flow at 2000 hertz.

"This technology is versatile, and expected to enable real-time measurement and control of fluid flow in various fields," said Nonomura. "Thanks to the combination of a low-dimensional model and optimization—even for measurement methods involving tedious analysis—the amount of data analyzed is significantly reduced."

More information: Naoki Kanda et al, Proof-of-concept study of sparse processing particle image velocimetry for real time flow observation, *Experiments in Fluids* (2022). DOI: 10.1007/s00348-022-03471-0

Provided by Tohoku University

Citation: Real-time measurement of high-speed airflow is 20 times faster than conventional methods (2022, September 15) retrieved 26 April 2024 from https://techxplore.com/news/2022-09-real-time-high-speed-airflow-faster-conventional.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.