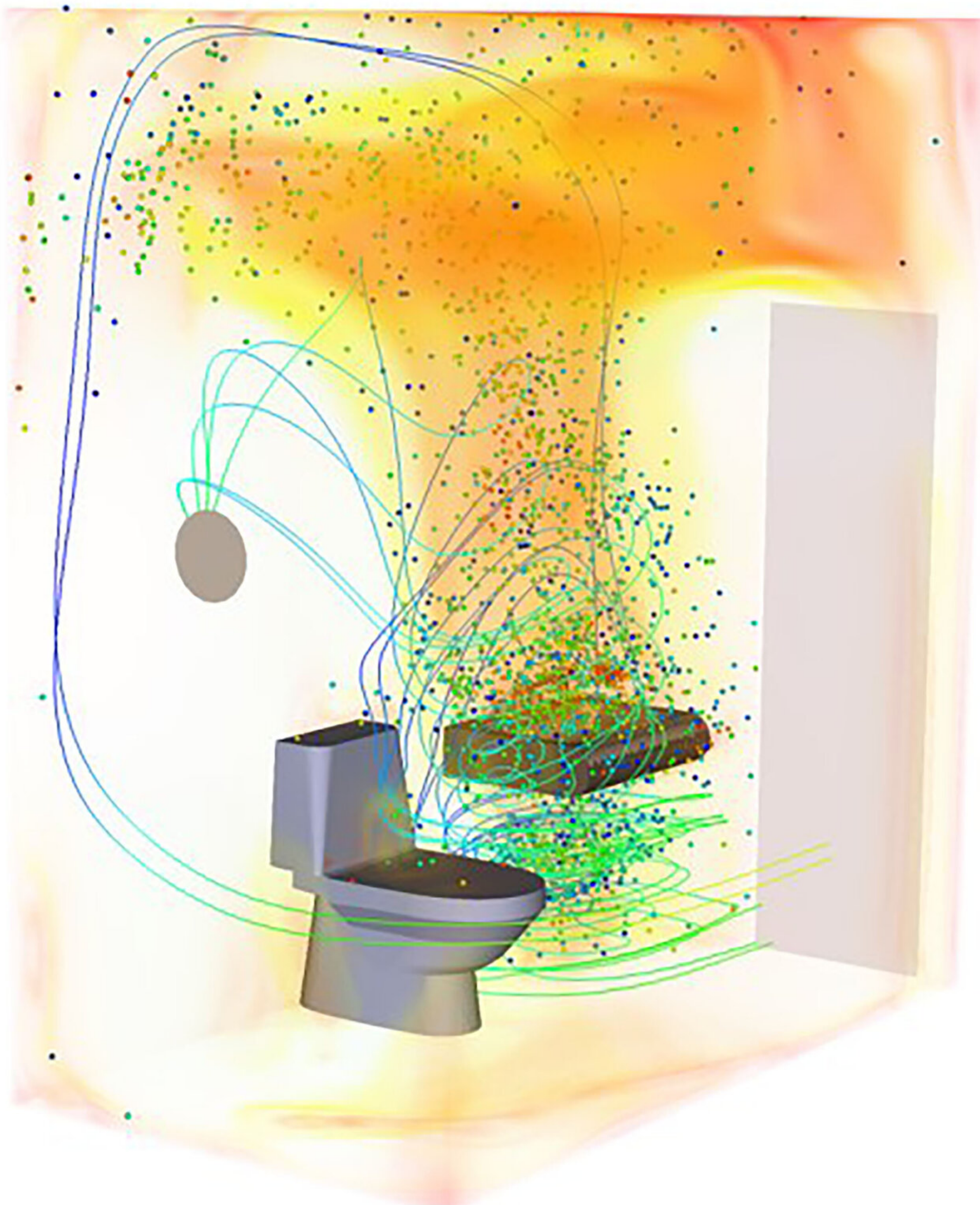
Ventilation matters: Engineering airflow to avoid spreading COVID-19

November 2 2021



Recirculating flow in a dead zone over the wash basin can trap infectious particles for a long time. Credit: Vivek Kumar, Ansys Inc.

As we approach two full years of the COVID-19 pandemic, we now know it spreads primarily through airborne transmission. The virus rides inside tiny microscopic droplets or aerosol ejected from our mouths when we speak, shout, sing, cough, or sneeze. It then floats within the air, where it can be inhaled by and transmitted.

This inspired researchers in India to explore how we can better understand and engineer airflow to mitigate the transmission of COVID-19. To do this, they used their knowledge of airflow around aircraft and engines to tailor the airflow within indoor spaces.

In *Physics of Fluids*, they report computer simulations of airflow within a public washroom showing infectious aerosols in dead zones can linger up to 10 times longer than the rest of the room. These dead zones of trapped air are frequently found in corners of a room or around furniture.

Washrooms generate aerosols and are present within offices, restaurants, schools, planes, trains, and other public spaces. They have been identified as a potential source of infection transmission within densely populated areas in India.

"We explored a small, single-person facility used by many, one after another," said Krishnendu Sinha, a professor of aerospace engineering at the Indian Institute of Technology Bombay. "I have a similar washroom in my house, which made it easier to study it. Mobility was restricted, and laboratories were closed, but this allowed us to continue our study during the lockdown."

The researchers discovered that chances of infection are significantly higher in a dead zone.

"Surprisingly, they can be near a door or window, or right next to where an air conditioner is blowing in air," he said. "You might expect these to be safe zones, but they are not."

Computer simulations show "air flows in circuitous routes, like a vortex," said Vivek Kumar, a co-author. "Ideally, air should be continuously removed from every part of the room and replaced by fresh air. This isn't easy to do when air is recirculating in a dead zone."

The biggest questions around airflow center around how to ventilate indoor spaces to minimize infection spread. Where should fans and ventilation ducts be placed? How many of them? How much air should flow through them?

"Currently, ventilation design is often based on air changes per hour (ACH)," said Sinha. "These design calculations assume fresh air reaches every corner of the room uniformly. From computer simulations and experiments within a real washroom, we know this does not occur.

"ACH can be 10 times lower for dead zones. To design ventilation systems to be more effective against the virus, we need to place ducts and fans based on the air circulation within the room. Blindly increasing the volume of air through existing ducts will not solve the problem."

More information: "Effect of recirculation zones on the ventilation of a public washroom," *Physics of Fluids* (2021). aip.scitation.org/doi/10.1063/5.0064337

Provided by American Institute of Physics

covid-.html