WEBINAIRE

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Manouk Abkarian

CNRS Research Director, HDR

Dept. of Biophysics and Bioengineering, CBS - Centre de Biologie Structurale Montpellier

Inscription : laurent.lacaze@imft.fr

Fluid dynamics of speech: Mechanisms underlying pathogen transmission

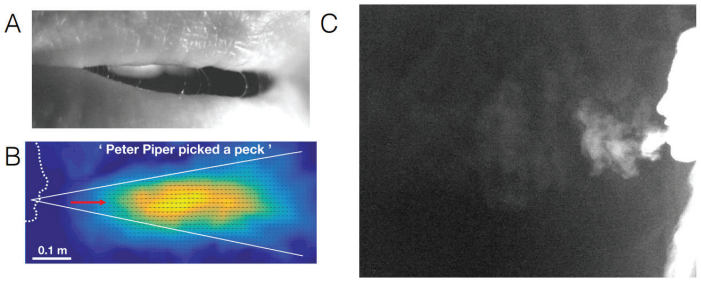

Figure (A) Close up of a mouth saying 'Pa'. (B) Average Flow Velocity indicating a conical jet-like structure when saying 'Peter Piper picked a peck', (C) CO2 exhaled air flow from a Mezzo Soprano Singer singing 'Oror' an Armenian Lullaby.

Speech is a potent route for viral transmission in the COVID-19 pandemic. Informed mitigation strategies are difficult to develop since no aerosolization mechanism has been visualized yet in the oral cavity nor has the relationship of speech to the exhaled flow been documented. Here we show first with high-speed imaging how phonation of common stop-consonants form and extend salivary filaments in a few milliseconds as moist lips open or when the tongue separates from the teeth. Both saliva viscoelasticity and airflow associated with the plosion of stop-consonants are essential for stabilizing and subsequently forming centimeter-scale thin filaments, tens of microns in diameter, that break into speech droplets. These plosive consonants induce starting jets and vortex rings that drive meter-long transport of exhaled air, tying this drop-formation mechanism to transport associated with speech; the transport features, including phonetics, are demonstrated using order-of-magnitude estimates, numerical simulations, and laboratory experiments. We believe that this work will inform thinking about the role of ventilation, aerosol transport in disease transmission for humans and other animals, and yield a better understanding of "aerophonetics."

Contact : sig_communication@imft.fr

Institut de Mécanique des Fluides - 2, Allée du Pr Camille Soula, 31400 Toulouse.