Aerospace Research Laboratory

Our group conducts cutting-edge research on hypersonic air breathing propulsion, supersonic aerodynamics, hypersonic ground and flight test techniques, diagnostic and measurement technique development, and blast wave effects. Major projects include examining the turbulent flame structure associated with a flame holder in the combustion chamber of a scramjet engine, and the examination of control strategies for optimizing performance of scramjets.

Hypersonic Air Breathing Propulsion

Given global military trends, there is considerable interest in research to increase the flight speed of atmospheric aerospace systems. There is also interest within civil space programs for improving the safety, efficiency and cost associated with launches into space. Scramjets, and the promise of air breathing hypersonic propulsion, present the opportunity to replace existing conventional technology to achieve these goals. A scramjet is an air breathing jet engine that maintains airflow at supersonic speeds during combustion. Whereas a ramjet, or regular aircraft engine, slows the air down to subsonic speeds before combustion, a scramjet keeps the airflow supersonic while the fuel is added and combustion takes place. By using oxygen in the atmosphere, the vehicle does not need to carry oxidizer, thus reducing the launch mass, and increasing the efficiency of the vehicle. Our lab is working to better understand how a scramjet works and to help improve the accuracy of tools for the prediction of scramjet performance and operation.

Christopher Goyne

Associate Professor
goyne@virginia.edu
www.mae.virginia.edu/NewMAE/mae-faculty/christopher-goyne/

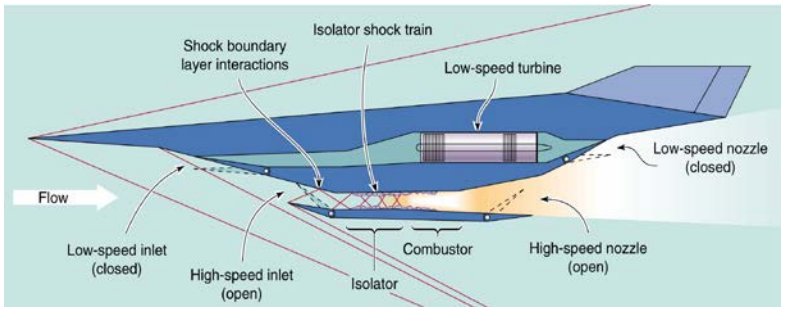
Dept. of Mechanical & Aerospace Eng.
University of Virginia
Charlottesville, VA
434.982.5355

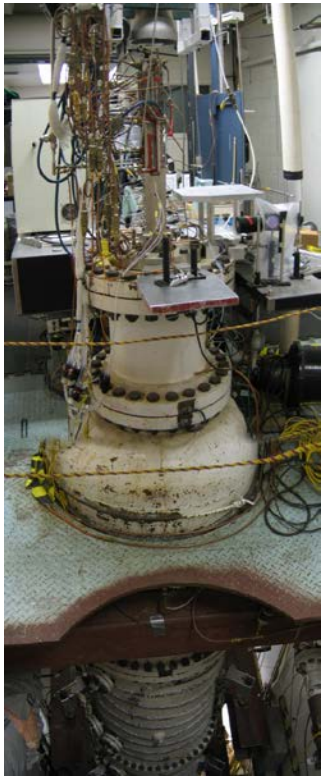
"Conducting basic and applied research in advanced aerospace technologies."

UNIVERSITY of VIRGINIA
ENGINEERING

Hypersonic Ground & Flight Test Techniques

We are working to resolve test effects related to the operation of scramjet engines in wind tunnels and in flight experiments. Given the nature of the high temperature flows involved, scramjet technology must be developed using a combination of ground and flight testing. In order to accurately predict ultimate system flight performance, it is important to understand the effects that test techniques have on scramjet performance and operability. For example, the University of Virginia Supersonic Combustion facility is electrically heated and the test air is free of combustion vitiation that can affect the performance of scramjets in many other ground test facilities around the world.





Diagnostic & Measurement Technique Development

We collaborate with NASA and the US Air Force to develop novel diagnostics and measurement techniques related to hypersonic air breathing propulsion. In particular we have developed a new way to efficiently and accurately conduct Particle Image Velocity (PIV) in high-speed, combusting internal flows. This approach can effectively measure both two-component and three-component velocities in high-speed flows that are bounded by the windows that are being used for optical access.

Rotating Machinery and Controls (ROMAC) Industrial Program

The ROMAC group conducts collaborative research with industrial members in the areas of rotordynamics, turbomachinery, structural dynamics, magnetic bearings, automatic controls, the coupling of fluid flows with the dynamics of rotating machinery, fluid film bearings and seals. Some of the current projects include: rotating machinery support stiffness investigations, journal bearing behavior due to surface irregularities, and adaptive control approaches for machinery with limited knowledge of the plant model.

RECENT RESEARCH DEVELOPMENTS

- Developed new adaptive control approach for scramjet engines.
- Developed new experimental technique that is needed to understand the physics of scramjet combustion.
- Discovered new approach to efficiently operate scramjet engines.

RECENT GRANTS

- AFRL (via Innoveering LLC) - Active Control of a Scramjet Engine
- NSF and AFOSR - Turbulent Flame Structure of Cavity Stabilized Reacting Shear Layers: Effects of Flow Compressibility, Heat Release, and Finite-rate Kinetics
- US Army (via Henry M. Jackson Foundation) - Functional and structural changes in cerebral vasculature following exposure to blast overpressures associated with TBI in military personnel

SEAS Research Information
Pamela M. Norris,
Executive Associate Dean for Research
University of Virginia
Box 400232
Charlottesville, VA 22903
pamela@virginia.edu
434.243.7683

UNIVERSITY of VIRGINIA ENGINEERING