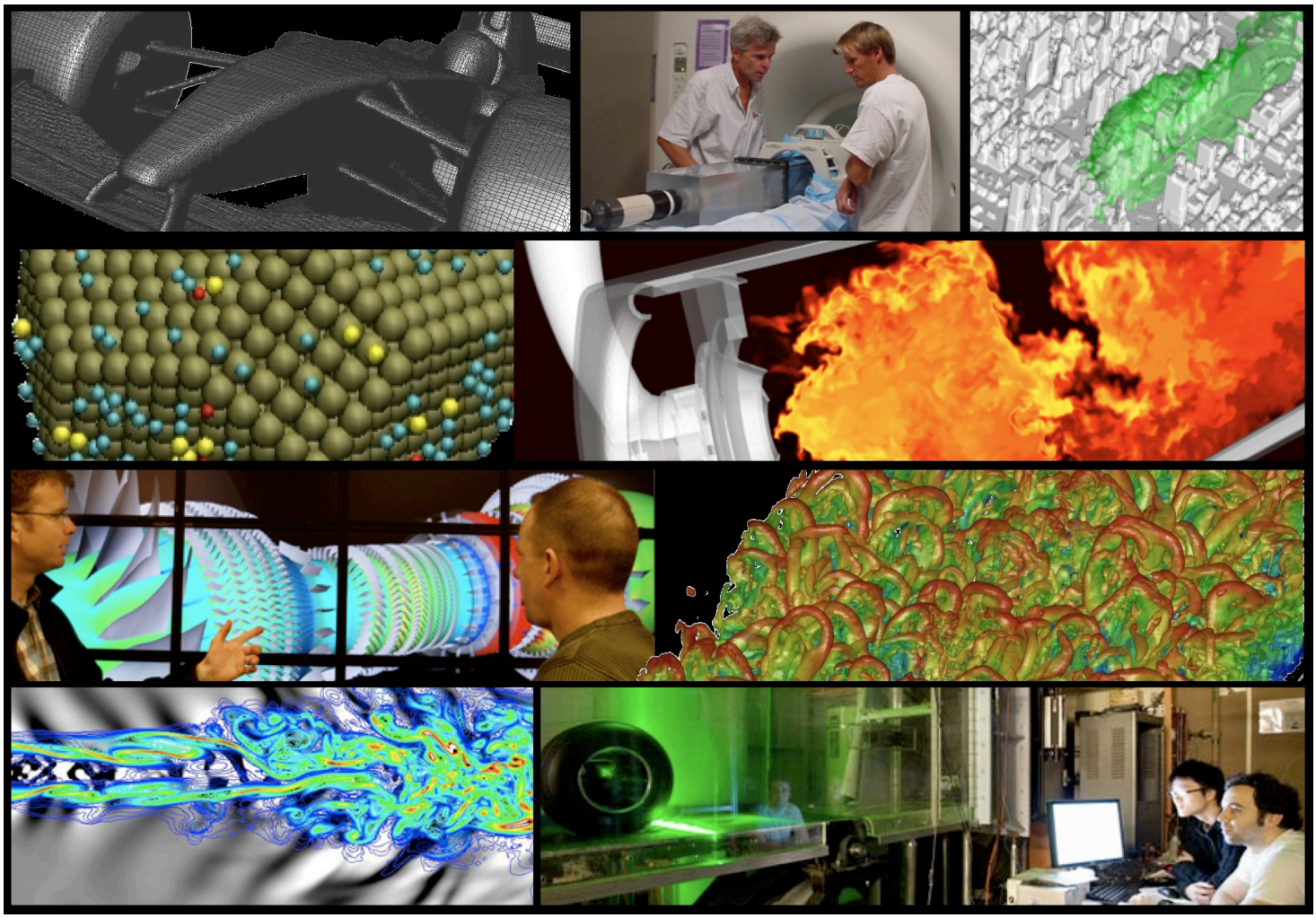
Thermal and Fluid Sciences Affiliates Program for Industrial/Academic Cooperation



Thermal and Fluid Sciences Affiliates Program

The Stanford Thermal and Fluid Sciences Industrial Affiliates and Sponsors Program (TFSA) is the industrial liaison program of the Flow Physics and Computational Engineering Group, the Center for Turbulence Research, and the Thermosciences Group of the Mechanical Engineering Department at Stanford University. The program was started over 40 years ago to establish and maintain close ties between the Stanford faculty and engineers in industry. The program serves as a two-way conduit of recent research findings and industrial problems that motivate new research. The program is administered at the faculty level and emphasizes direct communications between the Stanford faculty and the industrial representatives.

How does the program work

This is a person-to-person program, not an institutional one. The key to success is getting Stanford's faculty and industry's engineers working together on a first name basis. The interaction starts when the company enrolls in the program by completing an application, paying the necessary fee, and naming one of its own technical people as the primary contact point within the company.

The company chooses one member of the faculty to be their principal liaison person. While the choice is primarily up to the sponsor, the faculty person must also agree to the relationship. It is the liaison faculty member's responsibility to ensure that the company's needs are being satisfied as well as is possible through the Affiliates Program. The faculty contact and the company contact establish their own communications pattern.

The company representative reviews our current research projects and selects those for which he or she would like to receive research reports and theses. The faculty liaison person then arranges for reports from those projects to be sent to the company immediately upon publication. It is customary for the Stanford liaison person to visit the company site once per year, usually in the summer.

The biggest event of the year is the annual Affiliates Conference, a three-day technical meeting held each winter at Stanford. The meeting includes approximately 50 oral technical presentations by students and faculty, organized into topical sessions. In addition, research posters are set up in the coffee room providing focal points for discussion. Lab tours, cocktail hours, meals, and the banquet offer an excellent opportunity to meet the faculty and students and to initiate technical discussions. Many of the visitors stay for one of two days extra for more extensive consulting on their own projects.

What are the benefits to the company?

There are several. The easiest to recognize are the yearly faculty visit at the company site and the invitation of company representatives to the annual Affiliates Conference. This provides two face-to-face meetings per year, which is usually the basis for more extensive collaborations. Further, the Affiliates Conference provides a broad overview of the newest research of the respective groups at Stanford. The Stanford liaison person acts as an interpreter and guide to the work, either directly or indirectly and can ensure that the appropriate contacts with other Stanford faculty are made and that the new work is properly implemented in the company. Engineers from the member companies may also spend extended periods at Stanford working with our research staff. This includes specially arranged participation in CTR Summer Programs. In other cases, Stanford students or senior research staff may visit the companies for extended stays.

The direct transfer of scientific or technological information from Stanford's research programs to the member companies is ensured. Research reports from the Flow Physics and Computational Engineering Group, the Center for Turbulence Research, and the Thermosciences Group are sent to Affiliates before any general mailing or publication. This usually means a six-month to one-year advantage.

Another benefit comes from the development of a "first names basis" familiarity with the Stanford faculty. This makes it possible, and comfortable, to simply call up to discuss a new idea, to ask about some new process, or discuss a puzzling situation. Within reasonable limits, you have immediate access to your liaison person's experience. Sometimes the liaison person will be able to answer your question directly; sometimes they will be able to help you locate an expert in the field. The affiliated faculties are leaders in their fields and, through the Affiliates Program, can serve as your window on research, not only throughout Stanford University, but in other locations as well.

Each sponsor is invited to send representatives to the annual Affiliates Conference. At the time of this review, the students, postdoctoral scholars, and faculty involved present the current status of nearly all research for the sponsors. Such a meeting serves two purposes: it keeps the sponsor aware of the direction and present state of research at Stanford, and it familiarizes the sponsoring company with the postdoctoral researchers and students, both at the Master's level and the Doctoral level, currently in the program at Stanford.

The Affiliates program also facilitates professional recruiting. Your corporate liaison person can talk personally with our new Masters candidates every year, and follow the progress of our Doctoral candidates over three or four years. As the faculty and company representatives become more familiar with each other, it will become easier and easier to identify the Stanford students and postdoctoral research staff best suited for the tasks at hand and your hiring decisions will be more solidly based. A special session during the Affiliates Conference provides the opportunity for member companies to present themselves and potential job opportunities to our students and post-doctoral researchers.

There is one more benefit, more subtle but nonetheless important. Membership in the Affiliates Program gives you an opportunity to influence the course of future research at Stanford. Through your continued contacts with the faculty, you have the opportunity to interest them in your problems and affect their future research goals. Much of our research funding comes from government agencies – not from industry – and, within limits, the faculty can steer their research in any direction they wish: if they see an opportunity for interesting work in an area important to you, they will take it from there. They are much more likely to choose research topics relevant to your company's needs if they really understand the problems you face. Awareness and understanding of your problems will grow with continued contact, and through this awareness, you affect the course of our future research.

What are the benefits to Stanford?

There are two principal types of benefits to Stanford, one conceptual and one financial. The conceptual benefits are, themselves, two-fold. First, TFSA provides a window on current problems in industry, allowing our faculty to identify new areas where research is needed. Second, when the research is finished, discussing the results with TFSA members shows the faculty how their results are used, and what else needs to be done to make the work most useful. On the financial side, each sponsoring company makes an annual contribution of $25,000 to the Thermal and Fluid Sciences Affiliates Fund. A major part of this contribution goes to the liaison faculty member's Unrestricted Account, and can be used for student support, travel, equipment, or any other legitimate university expense. The fact that the liaison faculty member directly benefits from the program in such a tangible way encourages attentive service. The other half of the contribution goes to the TFSA General Fund, and is used for running the program, purchases of equipment for the common good, upgrading facilities not supported by the University, or any globally beneficial, allowable expense.

FPCE Group

Flow Physics and Computational Engineering Group

The mission of the Flow Physics and Computational Engineering Group (FPCE) is to provide new ideas, models, and computational tools for accurate engineering design analysis and control of complex flows (including chemical reactions, acoustics, plasmas, interactions with electromagnetic waves and other phenomena) of interest in aerodynamics, propulsion and power systems, materials processing, electronics cooling, environmental engineering, planetary entry, and other areas. A significant emphasis of FPCE is on physical modeling, computational engineering, uncertainty quantification, and analysis of engineering systems.

With rapid developments in computer technology, the future offers great opportunities for computational engineering analysis and design. FPCE blends research on flow physics and modeling with algorithm development, scientific computing, and numerical database construction and applications to systems involving flows. FPCE students and research staff are engaged in the development of new methods and tools for generation, access, display, interpretation and post-processing of large databases resulting from numerical simulations of physical systems. FPCE is closely connected with the *Center for Turbulence Research* (CTR), an internationally recognized institution for fundamental research on turbulence, and the *Center for Integrated Turbulence Simulations* (CITS), a multidisciplinary organization established in 1997 to develop a comprehensive program for flow and combustion simulation in propulsion systems under the Department of Energy's Accelerated Strategic Computing Initiative.

CTR

Center for Turbulence Research

The Center for Turbulence Research (CTR) is a joint enterprise of Stanford University and NASA-Ames Research Center. CTR has a large number of visiting scientists and post-doctoral scholars and has access to the world's largest supercomputers and wind tunnels. The pacing item for new turbulence model development is not computers or codes; it is new ideas. CTR's principal objective is to stimulate significant advances in the physical understanding of turbulence leading to improved capabilities for control of turbulence and to turbulence modeling for engineering analysis.

Although the emphasis of the CTR is to advance the understanding of turbulent flows for engineering applications, it is an interdisciplinary program; researchers with interest in turbulence from mathematics, aeronautics, meteorology, physics, oceanography, and other area conduct their studies at the CTR.

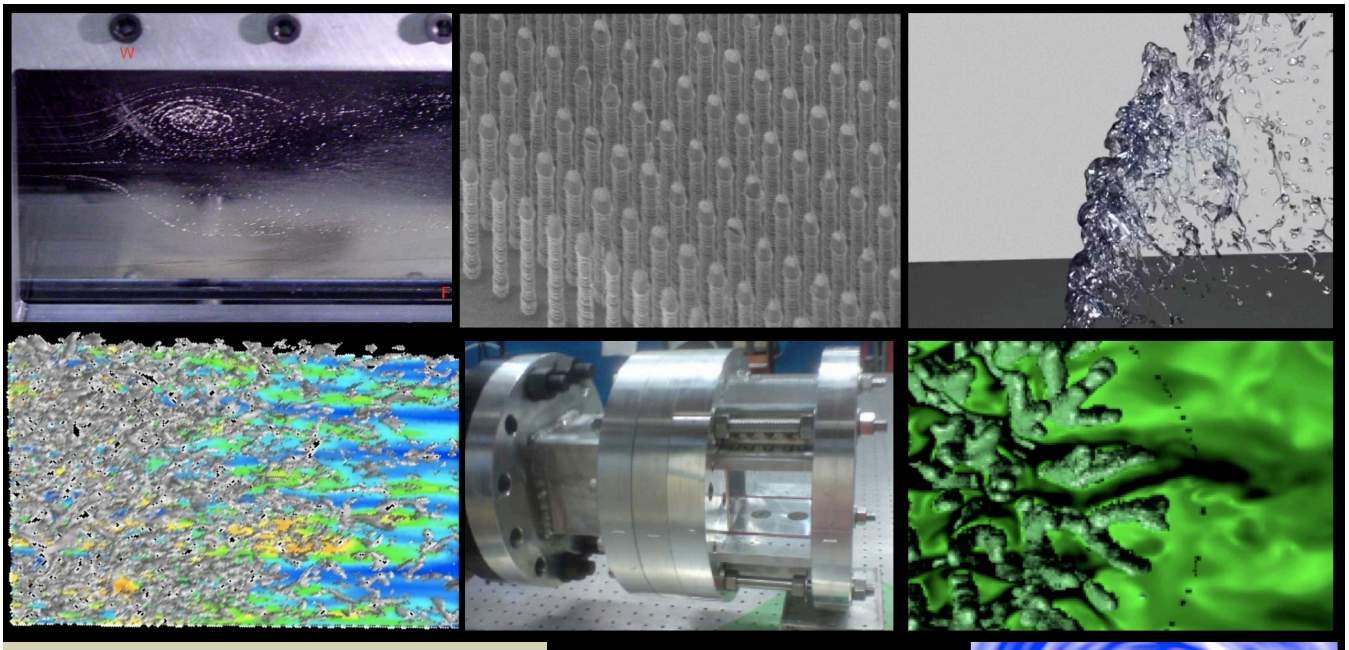
Current research projects include: large eddy simulations of complex turbulent and transitional flows, including studies of compressibility effects on turbulence; shock wave/turbulence interaction; turbulent mixing, heat transfer with application to electronic cooling, combustion, aerodynamics noise and hydro-acoustics; structure and mechanics of turbulent shear flows; active and passive turbulence control including applications of optimal control theory; fundamental turbulence modeling for applications, including effects of flow compressibility, rotation, solid boundary, flow separation, and chemical reactions; sub-grid scale modeling for large-eddy simulation of complex flows and non-equilibrium turbulent flows; and the development of algorithms for systems with broad range of scales in complex geometry, and parallel computing.

TSD Group

ThermoSciences Group

Research in the Thermosciences Group combines traditional emphasis in fluid mechanics, heat transfer, thermodynamics, and combustion with understanding physics-based models of use to the engineering community. Applied research in areas ranging from temperature transients in transistors, to heat transfer in gas turbines, to diesel engine combustion, to arcjet thrusters also is conducted in the Group. Current areas of emphasis include flow and heat transfer in complex turbulent flows, multiphase flow and combustion, plasma/surface interactions, high-speed combustion, laser-based flow and plasma diagnostics, heat-transfer in microscale electronic devices, thermal nanomachining, and reaction kinetics.

The Group includes three main laboratory facilities, the High Temperature Gas Dynamics Lab (HTGL), the Heat Transfer and Turbulence Mechanics Lab (HTTM), and the Microscale Thermal and Mechanical Characterization Lab (MTMC). The HTGL houses research on high temperature, high speed, and reacting flows. The lab includes several shock tubes for study of both high-speed flows and reaction kinetics, a supersonic combustion wind tunnel, a large plasma torch, several high-vacuum chambers, and extensive laser-diagnostics capabilities. The HTTM houses seven atmospheric pressure wind tunnels and two water channels, of various configurations, for research on turbulent flow and heat transfer. In addition, there is a tunnel for high Reynolds number research and a multiphase flow tunnel. The MTMC is a joint endeavor with the Design Group. The lab includes optical equipment for temperature measurement in semiconductor devices and interconnects with ultra-high spatial and temporal resolution, and a modified atomic force microscope designed to heat a highly localized area of a surface.



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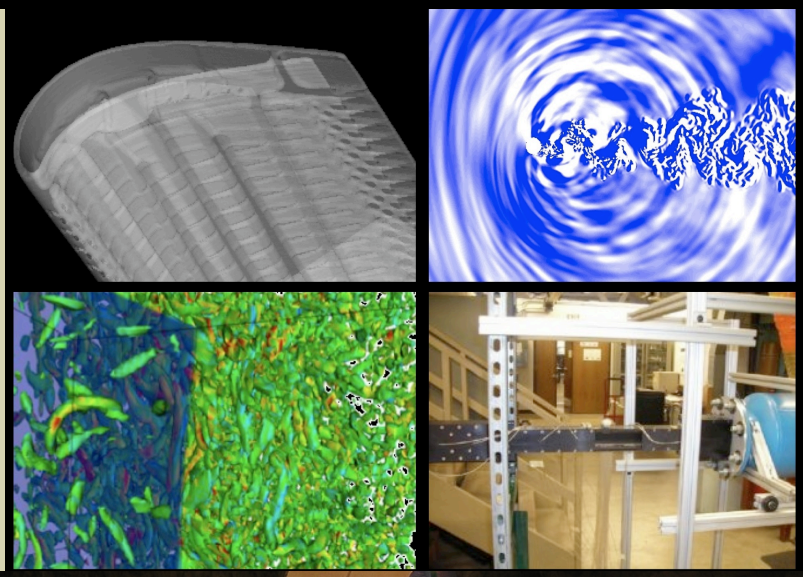

Thermal and Fluid Sciences Affiliates Program http://www.stanford.edu/group/tfsa
Flow Physics and Computational Engineering Group http://www-fpc.stanford.edu/fpc.html
Center for Turbulence Research http://www-fpc.stanford.edu/CTR
Thermosciences Group http://thermosciences.stanford.edu