AerospaceComputing, Inc.
465 Fairchild Drive, Suite 224, Mountain View, CA 94043
Phone: (650) 988-0388 Fax: (650) 988-0389

Dear Potential Customer;

AerospaceComputing, Inc.(*ACI*) is a small business engineering firm, established in 1989 with the following mission statement;

I. Develop new technology for the Aerospace Science community by applying state-of-the-art computer technology.

II. Provide scientific and engineering support to Government agencies and private industry.

From its beginning, *ACI* has conducted research and analysis for various customers both in public and private sectors and NASA Ames Research Center has been *ACI*'s major customer.

Currently *ACI* is participating in two major contracts with NASA Ames, one with Raytheon (Federal Information Processing Services contract) and the other with Sverdrup Technology, Inc. (Aerospace Testing, Maintenance and Operation contract). All *ACI* tasks on both contracts have resulted in average performance scores over 99%. *ACI* is an approved Protégé of Raytheon under the NASA Mentor-Protégé program. Through this program, Raytheon and *ACI* received the 1999 NASA Goldin-Stokes Mentor-Protégé of the year award. *ACI* has also been nominated for the minority subcontractor of the year in 2000.

In June 2000, *ACI* established a new office in Pasadena to pursue business opportunities at NASA's Jet Propulsion Laboratory (JPL). We are currently supporting the Uplink Consolidation Project under the Science Data, System Implementation and Operation (SDSIO) contract that Raytheon has with JPL.

If you have any questions, or there is anything we can do to help your business, please do not hesitate to call us at the number above. Attached you will find the Statement of Technical Capabilities for *AerospaceComputing Inc.*

Sincerely,

Hiroyuki Kumagai, D. E.,
President and CEO

ACI qualifies as an SDB, certified by the Small Business Administration.

AerospaceComputing, Inc. Technical Capabilities

AerospaceComputing, Inc.(***ACI***) can trace its roots to aeronautical research and research support activities conducted at NASA-Ames Research Center. The company has a very strong history in aerodynamics and flight vehicle dynamics. ***ACI*** has been and continues to be involved in a wide spectrum of aerospace research including theoretical, computational and experimental. Its highly skilled staff members encompass the diverse technical capabilities required to accomplish such research goals. These include: complex software development such as computational fluid dynamics and graphical data visualization tools, custom hardware design and implementation including embedded data acquisition/transmission systems and intelligent control systems, and instrumentation hardware design and implementation.

1) Trajectory Analysis

ACI developed and maintains the source code for a software tool to perform six degree-of-freedom analysis of planetary entries and ballistics range tests. The software (Comprehensive Aerodynamics and Data Reduction and Analysis - CADRA) has an internal computational component which calculates the spacecraft trajectory from the given aerodynamic coefficients.

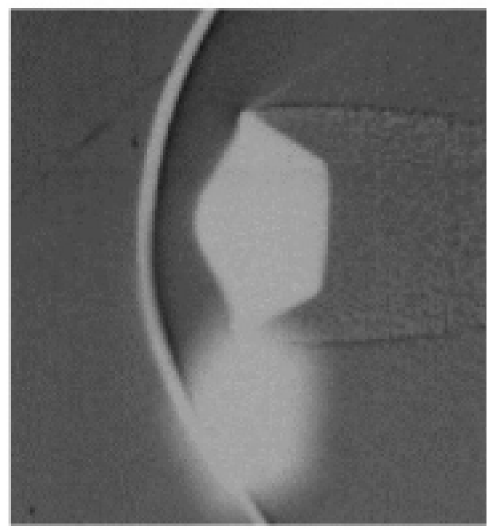


Figure1 Stardust model

During the hypervelocity free flight test in an aeroballistic range, a small model is shot by a gun into a test range. By applying an advanced image processing method built into the CADRA software, the trajectory of the model is determined with minimal human interaction. Then by applying a parameter identification method, the CADRA software can determine the aerodynamic coefficients from the trajectory data. It can handle highly non-linear aerodynamics.

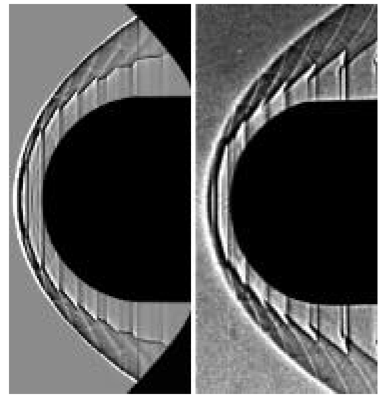
Using this software tool, important spacecraft design analysis for atmospheric entry/re-entry design, such as amplitude limit cycle analysis, can be performed.

The above figure shows a small-scale Stardust model tested at the Eglin AFB aeroballistic range in free-flight. The image was acquired and analyzed by the CADRA software. Spacecraft analyzed by CADRA include; Huygen, Mars Microprobe, Genesis, and the Mars Sample Return Capsule. Non-spacecraft atmospheric projectiles, such as tank penetrators, have also been analyzed by CADRA.

CADRA was originally developed for the USAF Wright Laboratory at Eglin AFB under a Small Business Innovation Research (SBIR) contract. This system is now commercially available from ***ACI*** as a turn-key system and the system has been installed at three Government sites (USAF/Eglin, NASA/Ames and Canadian Defense Ministry/DREV).

2) Image Processing

A long-standing specialty of ***ACI*** has been aerodynamic analysis through image processing. One of the first software tools created by ***ACI*** compared experimental image data to that generated by Computational Fluid Dynamics (CFD) methods. Initially developed to support research conducted at NASA-Ames Research Center, CISS (Constructed Interferogram, Schleiren, and Shadowgraph) models the optical systems of Shadowgraph, Schleiren, and Interferometry.



CFD Experiment

Figure 2 Image construction

Figure 2 shows an image constructed from a computed CFD flow field in comparison with an image acquired experimentally. This code validation model represents a semi-sphere in a high Mach number combustible flow. The figure shows the bow shock and combustible front in good agreement between the experimental and CFD solutions. The CISS code is currently being used by several Government facilities to analyze and evaluate high-speed aerodynamic bodies.

3) Software Development / Data Visualization

Custom software development is often required to achieve success for most research programs. ***ACI*** has developed software tools whose capabilites and specialties span the entire aerospace research spectrum. Such custom designs include: data acquisition and transmission, real time data processing and visualization, post processing and data visualization, real time device controls, image processing and film reading, and complex theoretical and experimental analysis. Every software package developed by ***ACI*** incorporates within the design a very user friendly Graphical User Interface (when user interface is required) and routines which are easily configurable for wide variety of applications following current Object Oriented programming standards.

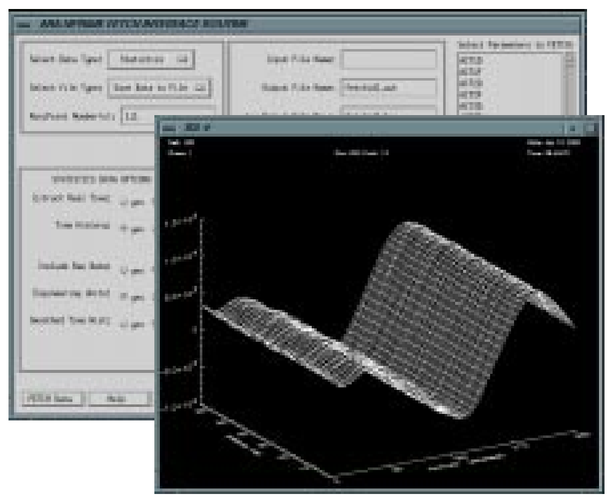


Figure 3 Data presentation software

Current hardware platforms in use include: Programmable Logic Control (PLC), Embedded Processor, PC, Macintosh, UNIX workstations, and supercomputers. The ***ACI*** staff is highly capable in a wide range of programming languages such as: C/C++, Java, FORTRAN, LabVIEW, MATLAB, IDL, Pascal, VisualBasic, HTML and XMOTIF.

4) Software Development / Systems Integration

ACI is currently conducting software design, development and systems integration at NASA's Jet Propulsion Laboratory (JPL) in support of NASA's Deep Space Network (DSN). The DSN is an international network of antennas that supports interplanetary spacecraft missions and radio and radar astronomy observations for the exploration of the solar system and the universe. The network also supports selected scientific Earth-orbiting missions.

Figure 4 DSN antenna at Goldstone, California

NASA's scientific investigation of the Solar System is accomplished mainly through the use of unmanned automated spacecraft. The DSN provides the vital two-way communications link that guides and controls these planetary explorers, and brings back the images and new scientific information they collect. All DSN antennas are steerable, high-gain, parabolic reflector antennas. Operated 24-7, these antenna are vital links between the spacecraft and the researchers. The figures to the right show antennas at two of the DSN sites.

Figure 5 Canberra, Australia

ACI also supports JPL's Telecommunications and Mission Operations Directorate (TMOD) in their upgrade of the command and control computers and software used to control and monitor the antennas. New computer hardware will reduce antenna downtime while new software will improve operator interaction and system reliability.

The software development support activities ***ACI*** is currently involved in include: overall software functional definition, program design, task interface protocol definition, programming and component and system level testing. The programming is conducted in C and C++, with a reliance on internal UNIX socket protocol for task communications. Real-time communications with the antenna hardware is required to monitor the current health. This is completed through the use of RS-232 lines and Ethernet connections.

5) Embedded Systems Technology

ACI specializes in developing embedded systems with integrated application specific hardware and software. One recent application of an embedded technology is a data acquisition and processing system, shown in Figure 6. This small, lightweight system includes 16 channels of analog front-end processors (instrumentation amplifiers, sensor excitation regulators, anti-aliasing filters) in conjunction with a digital subsystem (CPU, analog-to-digital converter, digital-to-analog converter, discreet I/O system, and high speed data transmission board). The entire system fits within a compact 14 cm by 14 cm by 18 cm enclosure.

Figure 6 Embedded data acquisition system

This latest system is used to transmit digital signals from a strain gauge balance system in a high noise environment. ***ACI*** custom designed and built the analog front-end and combined it with a digital system based on COTS hardware (PC/104). NASA Ames researchers gave the system high marks for its self-calibration feature and its immunity to noise during digital data transmissions.

6) Optical & RF Data Transmission

The embedded data system described above was also applied to a data acquisition and transmission application from a rotating frame. ***ACI*** developed a system where high-speed data is transmitted through a defused infrared optical transmitter located at the center of rotation. Device control is made available through a lower speed radio frequency (RF) link. This eliminates the need for a traditional electro-mechanical slip ring for data transmission and dramatically improves the signal-to-noise ratio. Figure 7 shows the system mounted on a rotating test bed (1' diameter disk).

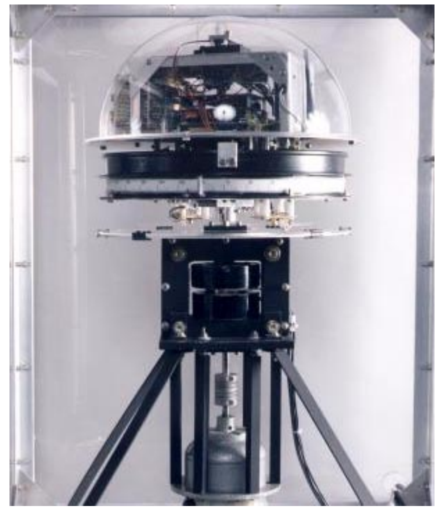


Figure 7 Rotating data system

The concept is further improved by use of a contactless magnetic slip ring for power transmission (shown in the middle of the figure). The contactless magnetic slip ring uses rotating and non-rotating coils coupled with high efficiency magnetic cores to transmit the power between stationary and rotating frames . The magnetic slip ring supplies all power required to operate any device within the rotating system. With the combination of optical and RF data transmissions, and the magnetic power coupling, this system completely eliminates traditional electro-mechanical slip rings. ***ACI*** holds the patent (U.S. patent 5,691,687) for the contactless magnetic slip ring design.

7) Intelligent Systems

ACI is currently expanding its knowledge of embedded systems to include intelligent, autonomous flight control concepts. ***ACI*** is currently developing an intelligent flying instrumentation platform for use in full-scale wind tunnels.

Figure 8 Intelligent data collection probe

An adaptive flight control algorithm incorporating neural network techniques is embedded into the control system of this flying probe (shown in Figure 8). Designed to fly around a test article, it must negotiate the dynamic wake behind the test article quickly and safely while maintaining a steady platform for acquiring data.

The flying platform has one embedded system dedicated for flight control and a second embedded system dedicated to research data acquisition and transmission.

8) Digital Signal Processing

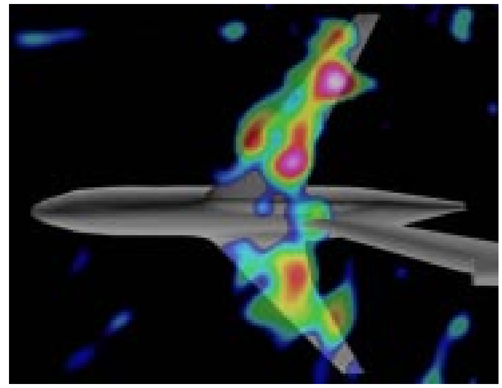


Figure 9 Acoustic contour map

With the advancement of computer systems and instrumentation, the amount of useful data that can be acquired continues to increase exponentially. This requires the use of large data array storage and manipulation methods to process all the data in a reasonable amount of time. ***ACI*** utilizes and develops software to apply the latest array processing techniques to highly dynamic acoustic and pressure sensors. Utilizing these advanced array signal processing techniques has generated useful data at signal levels below current single sensor capability. ***ACI***-generated software applies Fast Fourier Transform algorithms to large quantities of array data, generating 2-D contour maps that are used to evaluate experimental results.

As an example, an acoustic sensor array with 100 dynamic pressure transducers was used to determine acoustic source locations on a subsonic transport model. Using advanced digital signal processing algorithms, useful data were acquired and analyzed up to 80 kHz. Figure 9 presents a resulting contour map of airframe noise. It clearly shows the flap and slat noise sources with the noise level quantified for each located source. The contour plots were calculated for multiple frequencies. Further processing evaluated individual sources, integrating them to yield relative contributions.

9) Aerospace Testing

Figure 10 Tilt Rotor Acoustic Model

From the beginning of the company, ***ACI*** has performed a number of full-scale and small-scale wind tunnel tests and flight tests of fixed wing and rotary wing aircraft. The scope of activities include aerodynamics, flight dynamics, aeroacoustics, structural design and analysis, flow visualization and measurement, strain gauge balance design and calibration.

Figure 10 shows the Tilt Rotor Acoustic Model, a key NASA program in which ***ACI*** provides critical personnel and expertise. This test program is the most complex model ever designed for ground based testing. ***ACI*** personnel provide structural, static and dynamic design and testing, instrumentation layout and evaluation, control system design, integration and testing, and data reduction and analysis.

10) Custom Hardware Design and Integration

Figure 11 Six component rotary balance

ACI has developed a number of customer application specific hardware. These include special analog signal interfaces such as instrumentation amplifiers and filters, one-of-a-kind control systems and various instrumentation systems.

Figure 11 shows an example of a high-precision six-component rotary balance. ***ACI*** has been responsible for custom design, calibration and data reduction and analysis. The calibration and data reduction and analysis methods employ Neural Net Algorithms for higher accuracy and efficiency.

11) Computer System Services

ACI's systems administrators are proficient in PC, Macintosh and UNIX workstations. The computer systems service group is currently supporting 300+ workstations at NASA Ames Research Center. The ***ACI*** system service group maintains not only the user workstations, but also file servers, web servers, control system computers and card key systems. The group is also responsible for the contents of the NASA Wind Tunnel Operation Division's Web page.

12) Other technical areas

ACI provides various services, such as mathematical model analysis, data reduction and analysis, and design and implementation of software and hardware to technical areas such as flight simulation, human factor, and advanced air traffic controls. One unique aerospace application was the recent involvement of ***ACI*** in Mars airplane design studies. Two designs, a subsonic airplane powered by an electric motor and a rocket powered, direct entry, hypersonic airplane were examined.

Summary of *ACI* Strengths

ACI has highly skilled, motivated technical staff and ***ACI*** has been renowned for providing creative solutions to scientific and engineering challenges. All ***ACI*** staff members have significant interest and enthusiasm in aerospace research and development projects. Being a small company, ***ACI*** can readily adapt its unique capabilities to any engineering challenge.

Some photographs courtesy of NASA Ames Research Center, Jet Propulsion Laboratory, and USAF Wright Laboratory at Eglin AFB.