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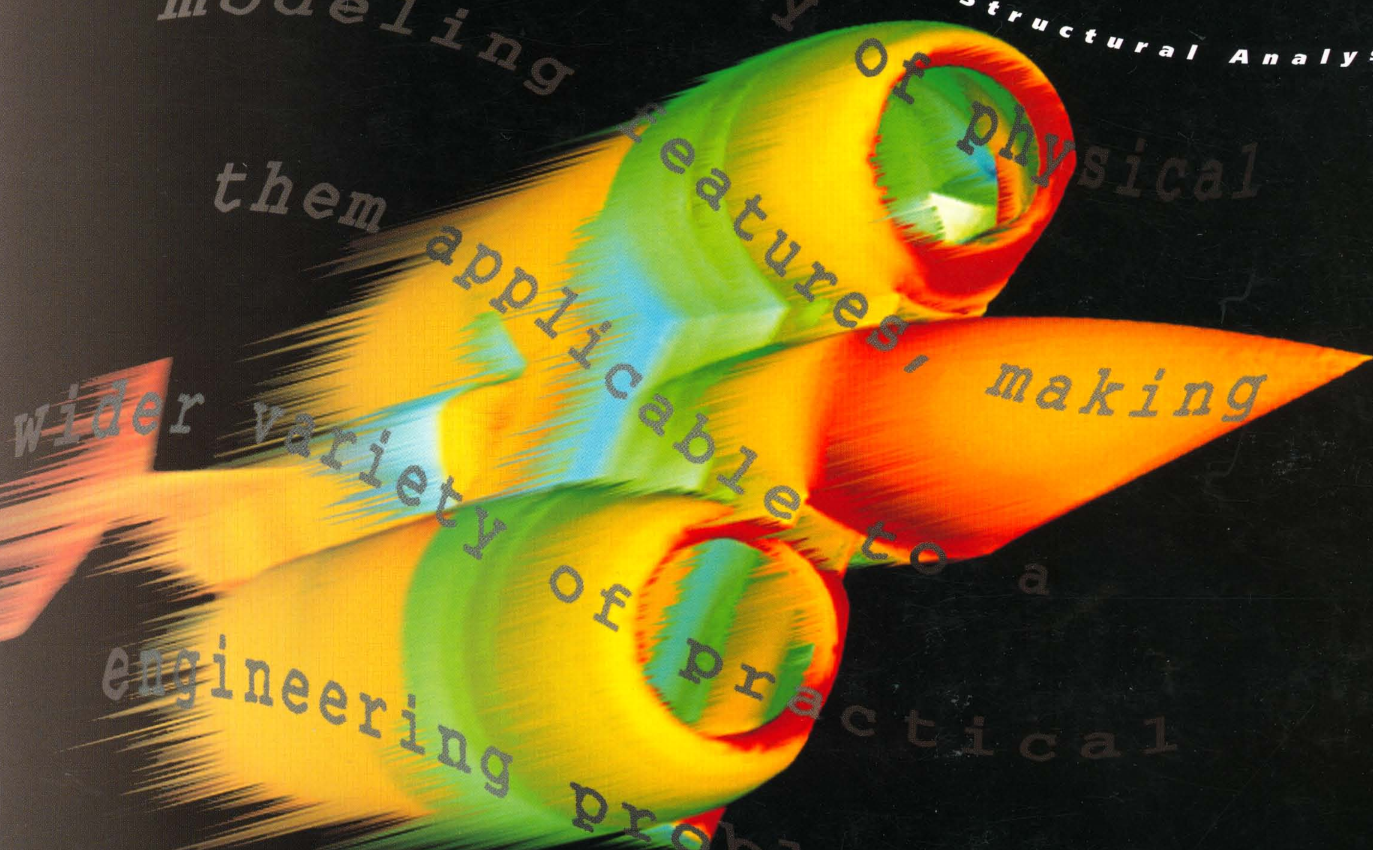

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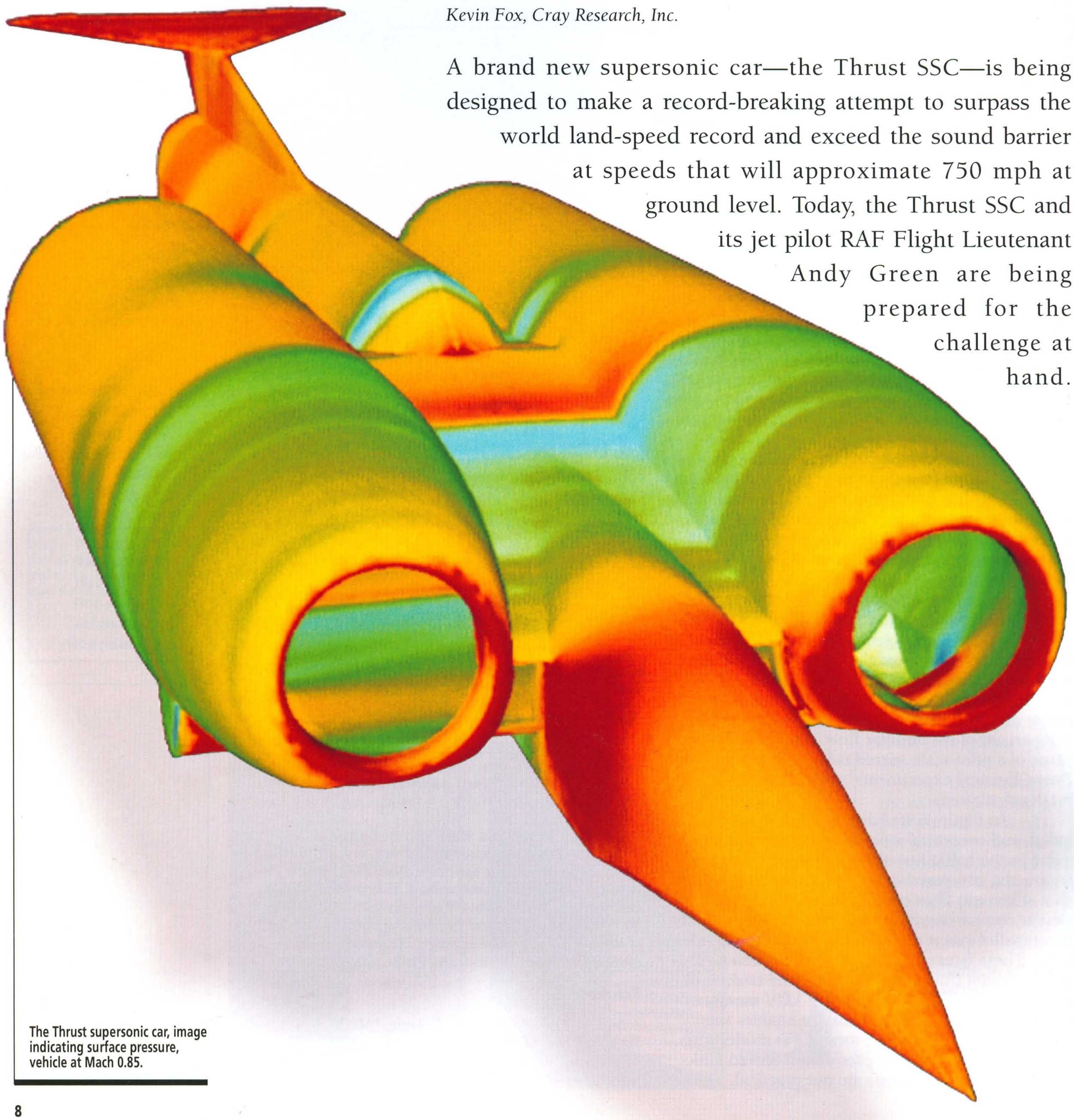
SUPERSONIC CAR

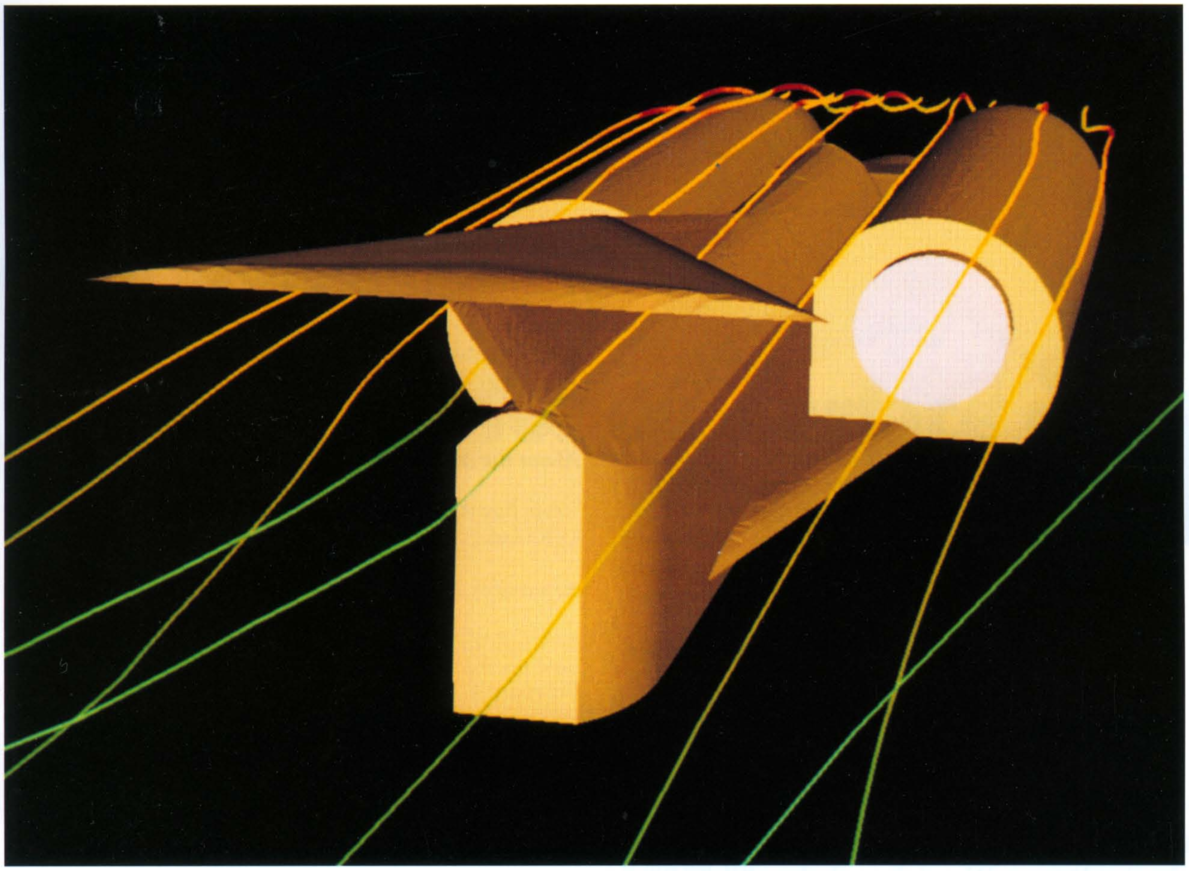
prepares for race against the sound barrier



The Thrust supersonic car, image indicating surface pressure, vehicle at Mach 0.85.

Kevin Fox, Cray Research, Inc.

A brand new supersonic car—the Thrust SSC—is being designed to make a record-breaking attempt to surpass the world land-speed record and exceed the sound barrier at speeds that will approximate 750 mph at ground level. Today, the Thrust SSC and its jet pilot RAF Flight Lieutenant Andy Green are being prepared for the challenge at hand.



Airflow streamlines, vehicle at Mach 0.85.

The Thrust SSC project is being spearheaded by Richard Noble. This is not the first time that Noble has been involved in a record-setting adventure of this kind. Noble—"the fastest man on earth"—set the land-speed record twelve years ago in the Thrust 2 at a speed of 633.5 mph.

With the help of a retired aerodynamicist, Ron Ayers, and several companies and engineers, Noble's idea for the new Thrust SSC is well on its way to becoming a reality. It was a chance meeting between Noble and Ayers, the lead designer of the Thrust SSC, that set the project in motion over two years ago. Since then a variety of UK companies have provided the sponsorship needed to complete the project either by offering services-in-kind or direct financial funding. Now, Noble and Ayers are busy building a car that could very likely earn them a page in history.

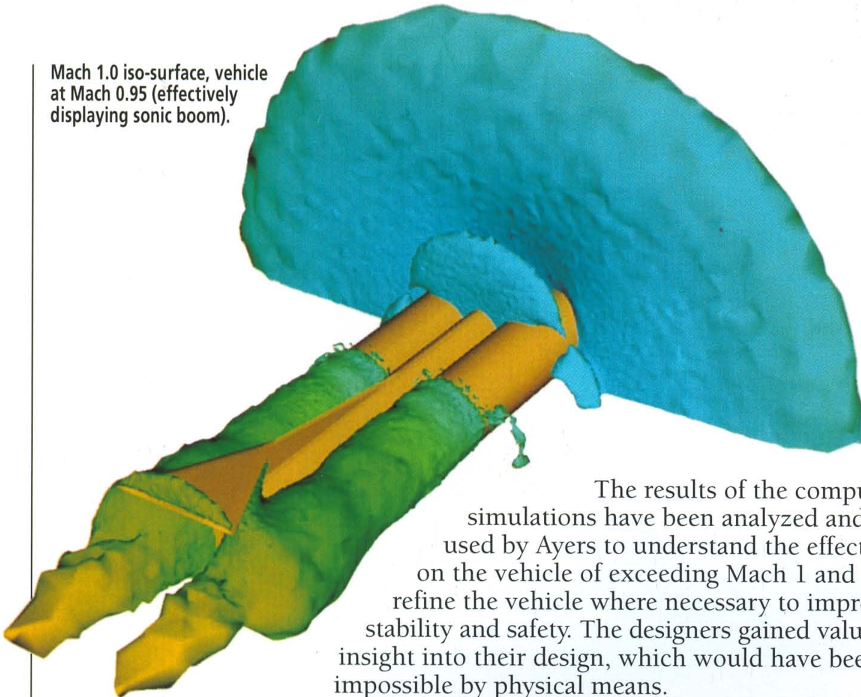
Clearly, if the attempts to break the world land-speed record and the sound barrier are going to be successful, the Thrust SSC is going to need raw power—enough power, for example, to launch the car from 0 to 800 mph in less than a minute. Achieving the sheer power for a project such as the Thrust SSC requires a radical design. The Thrust SSC features a tubular steel and carbon composite structure with a totally unique rear wheel steering system. Power is provided by two side-mounted Rolls Royce Spey 205 jet engines. This type of engine is normally found on jet fighter aircraft.

Approximately 54 feet long, this seven-ton, 100,000-horsepower land vehicle is the most powerful car ever built. The challenge in designing it lies in ensuring stability and control. At speeds in excess of 850 mph, even a small flaw can spell disaster. For instance, at supersonic speed, even the slightest twitch upwards (0.5 degrees) could cause the vehicle to flip over onto its back. Keeping the nose level is absolutely crucial to the safety of the Thrust SSC and a secret part of its design.

Evaluating the design of a land vehicle that can charge at supersonic speeds cross country is another challenge. To accomplish this task, the design of the Thrust SSC has been analyzed using a combination of state-of-the-art simulation and experimental testing. The state-of-the-art technology includes Cray Research supercomputers. As a sponsor of the Thrust SSC project, Cray Research offered services-in-kind to provide the computing time to evaluate the aerodynamics of the vehicle.

Using FLITE3D—an application system developed by Computational Dynamics Research and the Department of Civil Engineering at the University of Wales Swansea—Dr. Obey Hassan modeled the entire vehicle and studied the airflow around the Thrust SSC at various speeds on a CRAY C92 system. The boundaries of the computational domain are represented by an unstructured assembly of triangles, and the computational domain is represented by an unstructured assembly of tetrahedra. The computations assumed steady and inviscid flow and took account of the engine effects by defining appropriate engine inflow and outflow conditions. The steady state is achieved by means of an approach based upon explicit timestepping. Each simulation took approximately three hours on a CRAY C92 system.

Mach 1.0 iso-surface, vehicle at Mach 0.95 (effectively displaying sonic boom).



The results of the computer simulations have been analyzed and used by Ayers to understand the effects on the vehicle of exceeding Mach 1 and to refine the vehicle where necessary to improve stability and safety. The designers gained valuable insight into their design, which would have been impossible by physical means.

To further evaluate the design, experimental testing was done to study ground effects. A rocket-powered model of the Thrust SSC was created and launched down a track traveling at speeds as high as 850 mph. The results? The simulated ground effects closely matched the data gathered from the computer simulations. According to Hassan, "It was quite exciting to have the results of the simulation validated through the experiments." The data gathered through these and other tests are crucial to the continued progress of the project.

Despite these careful preparations, there is undeniably inherent risk in traveling at the speeds required to break the world land-speed record. Consequently, safety is a primary concern. Indeed, considerable design effort has gone into providing the driver, Andy Green, as much protection as possible against physical injury. The results of any test runs will be used to continue to improve upon or enhance the vehicle during the lead-up phase. The record breaking attempts will take place within the next two years.

When test runs and the supersonic car are completed, the plan is to take the Thrust SSC to the Nevada desert for its race against the record. The Nevada desert hosted Noble 12 years ago when he became "the fastest man on earth." Now Green is planning to go to the same place in man's historic challenge against the forces of nature.

About the author

Kevin Fox is an applications consultant at Cray Research (UK) Ltd.

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Acknowledgment

All images were produced using EnSight from Computational Engineering International, Inc. EnSight is a distributed, interactive results postprocessor for various applications including stress and computational fluid dynamics analyses.

Surface pressure with airflow streamlines, vehicle at Mach 1.15.