

Pulsing engines could double thrust

THE SPACE SHUTTLE could carry loads up to four times its present capacity in low earth orbits if new pulsing engine technology is adopted. This is the view of Ali AbuTaha, president of Dynamic Transients and exponent of unorthodox views on space flight (see also his article in *Professional Engineering*, 'Challenger failure - a design oversight?' July/Aug 1990, page 21.).

The principle is that of dynamic overshoot, similar to that experienced when stepping on weight scales and watching the dial overshoot before it settles down to the correct reading. The same idea of increasing forces is similar to that of the voltage doubler which was introduced by the electronic industry over 30 years ago, which doubles electrical output by clamping and rectifying the force signal.

AbuTaha says that the implications of dynamic overshoot have never been recognised before and systems would need extensive alterations before the principle could be adopted. However he believes that pulsing engines could revolutionise space travel. The effect has caused damage to space vehicles at take-off by the sudden start up of the rocket engine which AbuTaha believes has not been allowed for in the design.

After the main engines start they build up to full thrust and overshoot this value for a period of milliseconds, as does any object which is subjected to dynamic loading. Two steps are required to benefit from this process: first the overshoot force effect must be clamped and then it must be rectified. The result will be a force-doubling similar to that found in most radio and television sets.

The implications are considerable. By using pulsing-thrust technique in the space Shuttle main engines it will, says AbuTaha, be possible to eliminate the uncontrolled solid rocket boosters completely. With the lightweight pulsing engines the Shuttle would be able to carry 232 500 lbs (106 000 kg) into low earth orbit compared with 65 000 lbs at present. A NASA study shows that four boosters and four engines burning 6.5M lbs of fuel to launch 250 000 lbs (114 000 kg) into low orbit. With pulsing engines the Shuttle would achieve the same with less than a quarter the amount of propellant.

Also a typical communications satellite of say 8800 lbs (4000 kg) could be reduced by about 25% leading to benefits in cost, reliability, operational capacity and life.

Dynamic Transients Inc.
Virginia USA **Enter 198**

Cutting and shaping ceramics

PIONEERING RESEARCH is being carried out at Nottingham Polytechnic into machining ceramics by spark erosion which will have wide implications for manufacturing industry, from toolmaking to turbine blade production.

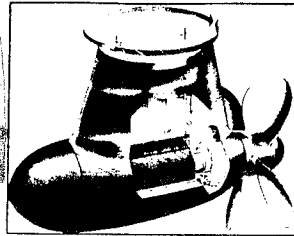
Outstanding resistance to high temperature, wear and deflection makes ceramics an attractive alternative to metals for many applications. But ceramics are brittle and cutting and shaping them is an exacting task so the obvious choices are laser cutting and spark erosion.

The brittleness of these ceramics means that they can be easily shattered by collision with the EDM electrode. Care must be taken to program the

correct feed rates and cutting parameters, especially important when semiconducting ceramics are to be cut. The pulsing across the spark gap, the very machining process which removes the workpiece material during machining can also shatter the ceramic.

By fine-tuning the operating system of the Charmilles Technologies machine, which normally automatically optimises the sparking parameters for eroding metals, excellent results have been achieved when machining ceramics. The findings will be made available when the thesis is published.

Charmilles Technologies
Stratford-upon-Avon **Enter 199**



A podded marine propulsion unit which can rotate through 360°, driven by a 20MW electric motor has been built in prototype form. The unit incorporates an AC synchronous motor inside the pod, controlled by a cycloconverter which gives full torque in either direction at speeds from 0-200 rev/min. Called Azipod the unit is suited for vessels needing high manoeuvrability, low noise and vibration levels, such as research vessels, cable and pipe laying ships, icebreakers, passenger and naval vessels.

ABB Stroma Drives
Helsinki **Enter 200**

No emissions from 'green' racing car

A NEW COMPANY has been formed to design, build and develop an electric racing car (Fig 1) to be called ZERO, the Zero Emissions Racing Organisation. Building the chassis and the auxiliary components will be undertaken by Lola Cars, the electronics-motors and batteries by Zetek Systems and the gathering of research data and information by Automotive Consultants.

The aim of the project is to build on the lead in international motorsport that Britain already enjoys to be leading with a 'green' car when environmental pressures begin to take force, anticipating the future of the electric vehicle which many see as the future for road transport. It is expected that the development will lead to technological spin-offs for conventional racing cars and to road vehicles.

The lightweight, environmentally friendly battery powered two-seater NA-S-Sport, designed and built by Horlacher AG has set a new world distance record. It travelled 547km

Liquid revolution

MOST COMMERCIAL LIQUID crystal displays, such as those found in watches and calculators, use 'twisted nematic cells' which change their molecular shape in response to an electric field. Greatly improved displays will be available when ferroelectric liquid crystals (FLCs) are commercialised.

FLCs have a permanent electric dipole moment that can be switched and applications include high-definition television screens, optical data communication and processing, and optical neurocomputers.

Physics World
Bristol **Enter 201**

Infrared welding. A new, non-contact method for welding thermoplastics using infrared heating can weld five times faster than conventional hotplate welding. The method avoids weld contamination and has potential for car body panels.
TWI
Cambridge **Enter 202**



Fig 1. This electric racing car emits no pollutants.

(341.8m) without its batteries being recharged taking over four hours at an average speed of 55.4 km/hr (34.6m/hr).

ZERO
London **Enter 203**
Ciba-Geigy
Basel **Enter 204**

Air bearing. A dynamically balanced air bearing spindle has been developed which offers vibration-free, almost zero friction, rotation at speeds up to 1500 rev/min.

Cranfield Precision Engineering Ltd
Cranfield **Enter 205**

Pulsing engines could boost Shuttle loads

BY TIM FURNISS
IN WASHINGTON DC

Pulsing-engine technology could enable the Space Shuttle to carry a load up to four times greater than its present capability into low-Earth orbit, according to Ali AbuTaha, president of Virginia-based Dynamic Transients.

The Space Shuttle has a maximum load capability of 29,483kg. The use of pulsing-thrust main engines, without solid-rocket boosters, could raise

Quayle calls for policy review as Cold War ends

US vice-president Dan Quayle has ordered that a review of the country's space policy be conducted "in the context of the end of the Cold War".

Quayle says that his space policy advisory board will look at two "...critical areas that are building blocks for a successful programme". First, he says that it will look at how the USA's "critical space-related industries" will be affected by the end of the Cold War. "Second, we need to stretch our scarce resources by figuring out how to do things faster, cheaper and better. We need a lower-cost launch system that's safe, reliable and responsive to military and civilian needs," he says.

On the subject of the environment, Quayle reports that the National Space Council is to speed up the US Government's work on identifying ways to prevent space debris and to protect against it.

"I strongly encourage other space-faring nations to join us, so that we can develop international standards for government and industry. We do not want this to be a serious problem for future generations," he says. □

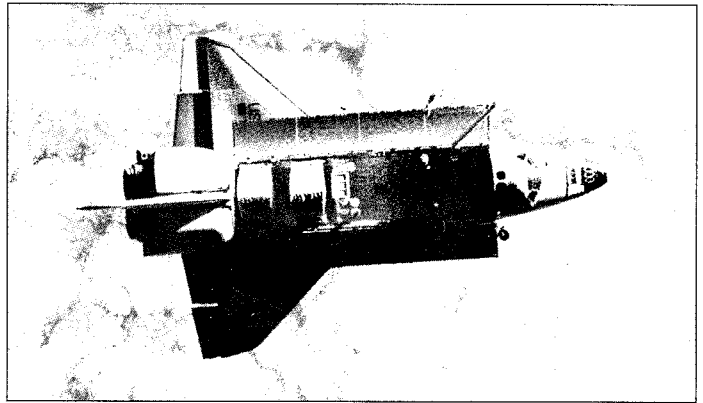
the capability to 105,500kg, AbuTaha says.

The force-increasing process is analogous to the voltage doubler, which was introduced by the electronics industry over 30 years ago. It doubles electrical output by "clamping" and "rectifying" the force signal.

The key to the engine is a phenomenon called dynamic overshoot. Dynamic Transients has gained an understanding of this under-researched phenomenon through independent investigations into a range of test and operational databases of space systems, including the Space Shuttle and Intelsat communications satellites.

"The extraordinary implications of dynamic overshoot have not been recognised before," said AbuTaha, speaking at the World Space Congress. "It will never happen overnight and existing systems would need extensive modifications, but pulsing-thrust engines could revolutionise our next era."

Any object undergoing a dynamic change of state is subject to the dynamic overshoot or force-magnitude effect, such as that created by the sudden start-up of a rocket engine. Although this effect has led to premature



New pulsing-engine technology could allow quadrupled Shuttle loads

structural damage and accidents, until now it has been largely disregarded, argues AbuTaha.

When the Space Shuttle main engines ignite and build up to full thrust of 5,005kN (1,125,000lb), they overshoot this steady state for a period of milliseconds, in the same way that jumping onto bathroom scales will produce a short-lived high reading.

The force on the vehicle measured after the STS 3 mission in March 1982 was equivalent to a thrust of 8,618kN, according to data produced by the Systems Dynamics Laboratory of NASA's Marshall Space Flight Center. This inadvertent measurement, however, was not investigated.

By pulsing the engines so that the dynamic overshoot effect is perpetuated, stored energy can be converted to increase performance, AbuTaha believes.

Pulsing engines have been used before (for example, on

thrusters for Intelsat 4 satellites) but their "increased efficiency" was not attributed to the dynamic overshoot phenomenon, which is inherent in any engine operation or physical movement.

Pulse-thrusting the main engines could enable the Shuttle to reach geostationary transfer orbit, says Dynamic Transients. The weight of typical communications satellites using pulsing thrusters and apogee motors could be reduced by 1,000kg.

Use of the concept on Ariane 4's first stage alone could double the performance of the three-stage vehicle, says AbuTaha, enabling it to achieve single-stage-to-orbit capability, which could also apply to the Atlas, Titan and Delta rockets. □

NEWS IN BRIEF

RUSSIAN LOAD

A US Department of Defense payload was flown aboard a recoverable Russian satellite, Resurs F, launched on 19 August, according to the US Naval Research Laboratory. The experiment, an aluminium-foil panel at the end of an extendable arm, was designed to gain a better understanding of the isotope Beryllium 7 which is produced by cosmic rays.

TETHER SNAG

A 50mm bolt may have caused the snag in the tether which stopped full deployment of the Italian Tethered Satellite during the Space Shuttle STS 46 mission in August. The bolt was part of a modification to strengthen the reel to increase safety.

NASA sets Titan 4 Cassini launch date

NASA has decided to launch its lightweight Cassini spacecraft on a Titan 4 Centaur booster on 13 October, 1997.

The spacecraft, reconfigured because of budget cuts, incorporates Europe's Huygens probe, which will explore the Saturnian moon, Titan.

Cassini will arrive at Saturn on either 25 June, 2004 or 15 November, 2004. This will depend on whether the vehicle is fitted with solid-rocket motors (SRMs) or advanced solid rocket motors (SRMUs).

Using SRMUs would accelerate the flight and allow a higher load of spacecraft propellant to

be carried, increasing on-orbit scientific data return and a closer fly-by of Titan.

United Technologies' SRMs propel the Titan 4, but the Hercules SMRUs will be available if funding from the US Air Force continues and if tests are successful. The first SRMU exploded during a test in 1991, but a second underwent trials earlier this year.

The Huygens probe will be deployed in December 2004 or May 2005. It will be parachuted onto Titan's ocean of liquid hydrocarbons in January or June 2005. Cassini's mission will be continued until 2008. □