

# IFR Automotive on a tech blitz

A plethora of patented technical innovations in the new Aspid luxury sportscar

could be applied to a wide range of vehicles, including mass-produced cars.



IFR Automotive's Ignacio Fernández (centre) along with his business partners Xavier Mallafre (left), Ana Sanchez (centre rear) and Breno Oliveira (right) showcase the Aspid at the British Motor Show last month.



Aspid premium sportscar weighs 700kg and packs several technical advances in the chassis, suspension, brakes and electrical systems.

**A**ward-winning Spanish automotive design and technology company IFR Automotive has revealed a wealth of weight, fuel and CO<sub>2</sub> saving technical innovations running throughout the chassis, suspension, brakes and electrical systems of its new Aspid luxury sportscar which made its world debut at the British International Motor Show on July 22.

The Aspid's minimal 700kg kerb weight is less than half the weight of a typical premium sportscar. With 400bhp available from its 2-litre supercharged engine, the virtually unmatched power-to-weight ratio gives terrific acceleration with the car hitting 100kph in 2.8 seconds and 160kph in 5.9 seconds.

The Aspid is also very compact — with a wheelbase smaller than a city car — and cleverly packaged to accommodate even the tallest driver and passenger. Despite its size, the fully enclosed two-seater is comprehensively equipped and as far removed from being a 'stripped down to the bare essentials' track-day special. It is essentially a premium sportscar designed for the road.

"The whole point of the Aspid is that it is small and lightning-fast, just like its namesake," says company founder Ignacio Fernández Rodríguez. "But we also believe it's the first genuine attempt at producing an unusually compact luxury sportscar, not just with impeccable roadholding and handling, but also with the highest possible quality. Our market research confirms the importance of a supercar having strong emotional appeal. It also has to be unique. This with the need for robust environmental credentials is what we've endeavoured to achieve with the Aspid."

Aspid has same power-to-weight ratio as a supercar but with half the vehicle mass.





IFR's SATI platform allows accurate prediction of vehicle performance and dynamic behaviour long before a prototype is built.

**Automotive Engineering**

IFR Automotive has developed an efficient design and engineering process to help create the next generation of vehicles required by manufacturers. It is based on the compilation of software libraries and the development of new computer code, providing a virtual platform for predicting vehicle dynamic behaviour and its feedback to the driver. The 'Sensitivity Analysis to Implementation' or SATI platform is not only a new design tool, but also allows IFR to accurately predict the performance and dynamic behaviour of a vehicle — based on the whole vehicle package and its complex dynamic variables — long before any prototype is built. IFR complements this development tool with other departments within the company, able to build and test prototype vehicles incorporating the new technology.



**Advanced weight saving initiatives**

Looking at the bigger picture, Fernández believes all the technical innovations the company has developed for the Aspid could be applied to a wide range of vehicles including mass-produced cars, thereby making a relevant contribution to sustainable personal mobility.

Underpinning its massive weight saving is Alexcom, an ultra-lightweight aluminium extrusion composite panelled chassis with a mass of just 75kg. The new and innovative construction method offers up to 10 times the torsional stiffness of a conventional aluminium spaceframe and enhanced crash protection.

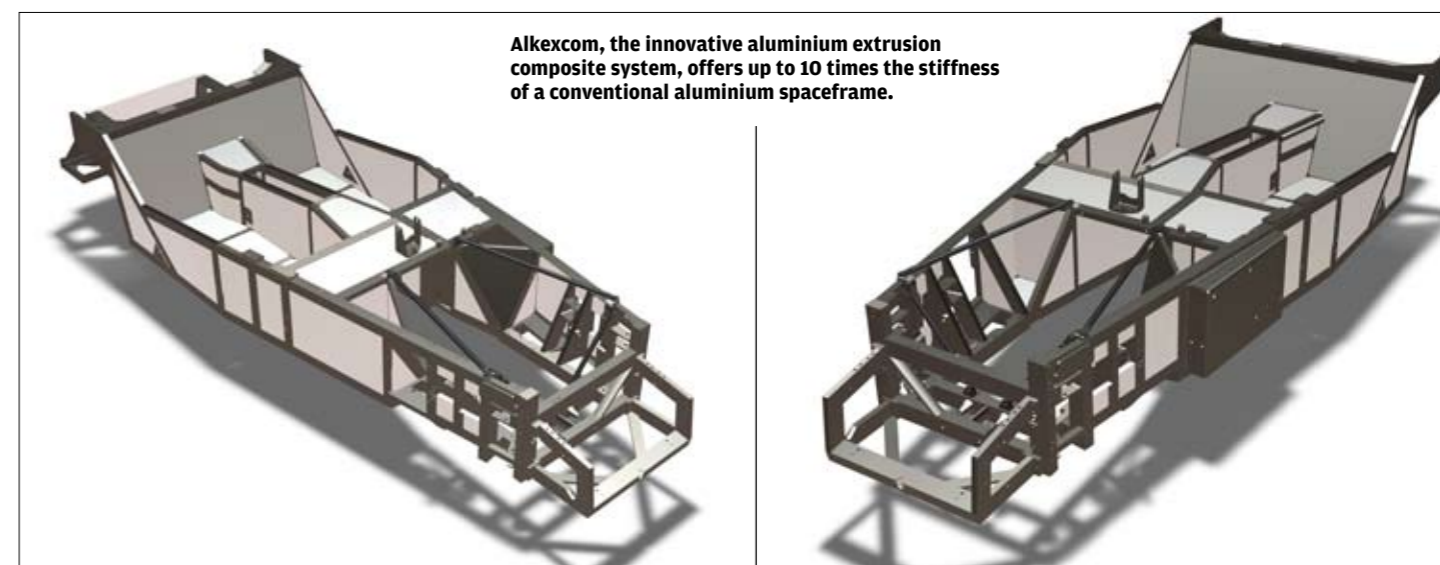
It has been developed for the double wish-bone system, with a special profile that provides immense stiffness and rigidity in all directions and minimises stresses under torsional, longitudinal and vertical bending loads.

Alexcom can be applied to a wide range of passenger, commercial and military vehicles and offers an immensely strong yet lightweight solution for maximising safety benefits and minimising environmental impacts.

Significantly, this new construction method has enormous potential to be industrialised for large scale series production. The beam elements can be easily bonded together and the manufacturing process lends itself to high level of automation. The system is protected by worldwide patents and is undergoing continual development by the company for different vehicle applications.

Many vehicles designed for low-volume production use steel or aluminium tubes formed into a simple three-dimensional structural framework, commonly referred to as a 'spaceframe', which serves both as a skeletal cage for the body panels, and as the structural lower part of the vehicle or chassis to which the suspension is attached. It also provides mounting points for the powertrain.

The spaceframe is essentially the starting point for building the entire vehicle, and its strength and stiffness is highly influential on many



Alkexcom, the innovative aluminium extrusion composite system, offers up to 10 times the stiffness of a conventional aluminium spaceframe.

aspects of vehicle performance.

Alexcom introduces a tubular beam with special cross-sectional features, including an internal diagonal spar with extensions to the profile designed to accommodate additional strengthening panels. These are incorporated into trapezoidal areas of the space-frame for additional reinforcement. The special profile tube has been extruded in aluminium to aerospace standards by Alcoa, which has been working closely with IFR Automotive, throughout the research and development phase, to help implement the company's very precise specifications for this critical component.

Normally the material specified by IFR for the panelling would be aluminium honeycomb sheet but other possibilities include carbon and even Kevlar; which can deliver an extremely sophisticated ultra-high-strength solution for military and motorsport applications.

Alexcom's special extrusion is smaller and less intrusive than conventional round or square tubes, which normally require the largest diameter (or diagonal) possible for maximum strength and stiffness. The design of the extrusion also helps minimise the number of elemental beams required in a space-frame. The overall result is that Alexcom offers significant weight reduction, which can help minimise a vehicle's carbon footprint. It also leads to smaller and more compact vehicle design, because it is less intrusive on the interior space required for occupants.

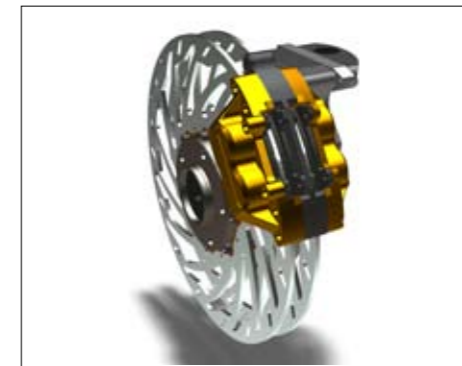
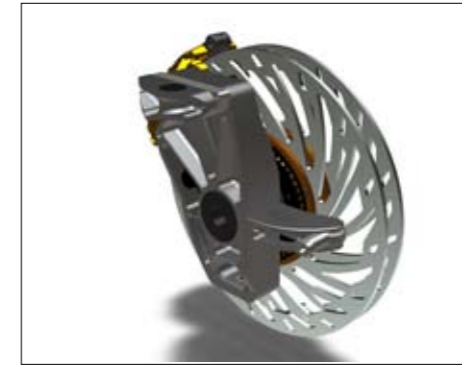
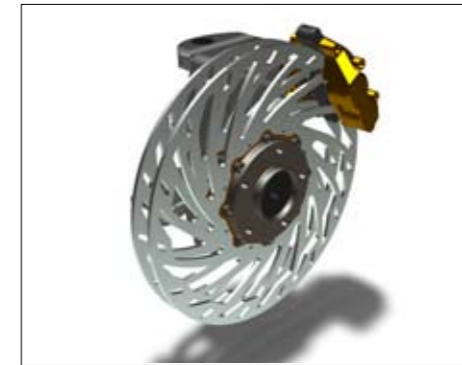
Alexcom offers substantial safety benefits with increased passive safety relating to occupant crash protection. It's more resistant to impact forces and the enhanced structural integrity improves energy absorption in a crash.

The improved mechanical performance also means much better car control. Active safety, which relates to a vehicle's ability to avoid the accident in the first instance, is improved because of the very high level of torsional stiffness that can be achieved, which improves road holding and handling.

In addition, the composite honeycomb structure is extremely well damped to minimise noise, vibration and harshness (NVH), which can help improve vehicle refinement.

Essentially, Alexcom transforms the simple aluminium space-frame into a sophisticated honeycomb shell-like structure that is immensely strong and rigid. When applied to a normal family saloon the torsional stiffness is conservatively estimated to be 90,000Nm/deg, which is almost three times that of the current best-in-class vehicle using a monocoque construction. And this is simply using Alexcom with aluminium honeycomb panels throughout, let alone with carbon or Kevlar reinforcement.

Alexcom can provide additional layers of protection. As demonstrated in the Aspid, the cabin is flanked with a triple-layer of protection, employing anti-impact foam sheets commonly used in the motorsport industry, sandwiched between the main space-frame structure and an additional outer section constructed using the same method of tubes and honeycomb panels.



**Key benefits of new twin brake disc system are maximum air cooling and braking efficiency, improved active safety, more traction, improved ride comfort, less fuel consumption and fewer emissions through ultra lightweight design, along with increased durability of brake pads and discs.**

### Twin brake disc system

The Twin Brake Disc system is another innovative patented technology from IFR Automotive. As the name implies, this lightweight stainless steel brake system comprises twin discs, each with turbine-shaped slots for maximum air cooling and braking efficiency.

The principal characteristic of this design is that heat is dissipated very quickly and doesn't accumulate, thereby permitting much thinner discs. The result is a significant weight saving of more than 70 percent compared with normal brake systems.

Having more than one brake disc also makes the calliper requirements smaller, and hence much lighter, further reducing the total mass of the brakes, which in turn helps to reduce the overall weight of the vehicle. In addition, a lower unsprung mass is immensely beneficial for a vehicle's ride and handling performance.

The main advantages of this system are maximum air cooling and braking efficiency, improved active safety from improved handling of the vehicle, more traction from increased contact of the wheel with the road, improved ride comfort, less fuel consumption and fewer emissions through ultra lightweight design, better feel of the brakes for the driver by avoiding the need for a servo, and increased durability of brake pads and discs.

IFR's expertise in vehicle dynamics has allowed the company to extract the maximum benefit from all this weight reduction, to provide the driver with massively enhanced feedback through the steering wheel, sublime handling and a superb grip of the road at all times thanks to the excellent balance it has achieved by using lightweight structures throughout the car.

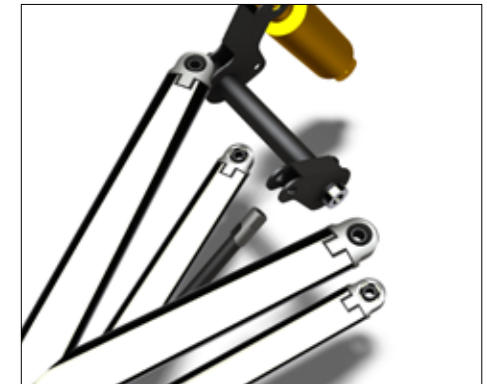
The impressive weight saving, however, doesn't end there. Aspid features an all-new and fully-integrated electronic and electrical system developed for the whole car. The company has reduced the usual complexity of these systems by eliminating countless components, assemblies and microprocessors.

### Suspension arm construction

IFR Automotive's major innovation in suspension systems is a lightweight suspension arm extruded from aluminium tube with an elliptical cross-sectional profile incorporating two reinforcement cords running throughout the extrusion. The special profile provides immense stiffness and rigidity in all directions helping to minimise stresses under torsional, longitudinal and vertical bending loads.

The elliptical form also provides a more efficient aerodynamic form. In addition, the special profile and internal cords provide an ideal socket to receive an aluminium end piece, which is then TIG welded to the suspension arm. Ample contact between the internal mating surfaces helps minimise any mechanical loading on the weld and guarantees an efficient joint.

An all-steel housing for the ball joint can then be simply bolted into the internal thread of the aluminium end piece. The overall design



ensures the transition from aluminium to steel is extremely robust, making sure the steel ball-joint is housed in a steel bearing.

This efficient design eliminates the reliability issues normally associated with a ball-joint operating directly in an aluminium housing. Overall, the design provides significant weight and stiffness benefits compared with current solutions for road and race cars. And when the ball joint needs replacing, with normal wear and tear, for ease of maintenance it is a simple matter to unbolt and replace the aluminium end pieces.

#### Unidrive electronics

Instead of the automotive industry offering a simple solution relevant to modern motoring needs, even cars that are supposedly state-of-the-art have a complexity of electronic and electrical systems performing myriad tasks with countless components, assemblies and micro-processors. Many are independently functioning sub-systems. The vastly complicated nature of having so many interrelated parts poses numerous problems ranging from wasted computing power to excessively heavy wiring looms and unnecessary switchgear. There are also cost, reliability, warranty and vehicle end-of-life issues. The industry's common vision, set out 10 years ago, of a simplified electronic architecture has simply failed to materialise.

IFR Automotive has applied its ingenuity to prove this vision can in fact be realised with Unidrive, which totally integrates an almost infinite number of electronic and electrical possibilities within a common system, as revealed in the company's Aspid technology demonstrator.

The most noticeable change for the driver and passenger, when experiencing Unidrive, is the complete elimination of the traditional instrument panels along with all the accompanying knobs and switches. Apart from the engine start button, just two screens replace all the normal instrumentation.

One screen is mounted in the steering wheel and the other is located in the centre console. In keeping with the latest digital technology trends, both displays are interactive touch screens. The primary screen provides information normally displayed by the main instrument panel, such as the speed of the vehicle, as well as providing the means, for example, to activate the headlights and turn signals.

**A special profile for the lightweight suspension arm helps minimise stresses under torsional, longitudinal and vertical bending loads.**

The secondary screen has endless telematics, on-board diagnostics and multimedia capabilities and not only integrates all the common communications systems currently available, but also provides the means to embrace any new developments including for example traffic management and collision avoidance systems. Any innovative sensor-based system introduced to the market or new application essentially becomes a plug-and-play item.

Either screen provides a means for the driver to communicate with the vehicle and indeed for the vehicle to communicate with the driver. And each screen can act as a back-up for the other. The replacement of conventional instrumentation with touch screens opens up much cabin space creating new possibilities for vehicle interior design.

Major benefits of Unidrive include a significant reduction in the amount of electrical harnessing required to around one-third that of current layouts, with a corresponding weight reduction. Similarly, there is a comparable reduction in the number of microprocessors to about one for every four that would typically be specified in a modern vehicle. So instead of having as many as 50 microprocessors, the Aspid demonstrator can manage with as few as seven and with no more than 10 needed for a maximum installation incorporating every single option available for the car. ■

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