



**PROTEAN**

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**Busting braking bias with in-wheel motors**

# Busting braking bias with in-wheel motors

Dr. Chris Hilton, CTO

As a pioneer in the in-wheel motor (IWM) field, we have faced and overcome various technical challenges developing ProteanDrive technology. One of these is the integration of a friction braking system into our compact in-wheel motor package. Our technology offers high power and torque density which is designed to maximise efficiency and simplify the vehicle production process, so we set out to develop a braking system to complement that. Working with internationally acclaimed braking specialist, Alcon Components, we have successfully integrated and packaged a friction brake within the package.

In-wheel motors necessarily occupy the space traditionally occupied by the brakes. As a result, the solution required a reconsideration of the design so that it packages with the IWM assembly and still delivers the requisite retardation performance. Further, we understood that to be viable for OEM customers (and ultimately the motorist) the system must be compatible, without any compromises, with all expectations placed upon modern brake systems such as ABS, stability control, emergency braking, hill start assistance and electronic parking brakes.

Currently, there is no existing automotive industry standard test for in-wheel motors, so we have developed our own proprietary design validation process by collating legislative requirements from across the globe on powertrain, suspension, high-voltage, electronic components and brake systems. While our IWM package supports regenerative braking, legislation essentially mandates hydraulic friction brakes on road vehicles. Protean engineers are working on delivering seamless brake operation by blending friction and regenerative braking to optimise energy re-capture.

To meet these standards, and to overcome the packaging challenge presented by the IWM occupying the wheel rim space, the solution engineered in conjunction with Alcon effectively flips the braking system inside-out. The brake disc (rotor) is mounted

to the outside of the motor rotor, next to the wheel rim. The caliper is then mounted upside down inside the disc. Using a cast iron caliper allowed for a compact design without losing the rigidity that is crucial for brake feel, while enabling original track-width to be maintained and avoiding excess bulk.



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Our work with Alcon enabled us to integrate a host of innovative design tweaks, including a parking brake mechanism, all within our in-wheel motor package. The development work included testing on a variety of passenger and light commercial vehicles to ensure not only the safety and validity of the brakes in meeting stringent standards, but also that functionality for steering and suspension could be maintained for optimum performance without compromise. Local Motors' Olli, the world's first 3D printed autonomous pod, is driven by Protean in-wheel motors and represents a major success story for our technology, including our brake system.

As well as our ability to offer a wholly integrated IWM propulsion solution for our customers, we have maintained an independent brake solution which enables us to work with our customers to develop their own braking solution suitable for the target vehicle application and specific design needs. For example, customers are starting to consider deleting rear brakes entirely or at least downsizing them for emergency and park-brake use only, while still meeting the current legislative constraints.

Our whole development process is both unique and comprehensive, and it strictly follows the ISO26262 Functional Safety process to ensure that our motors operate safely within the architecture of our customer's vehicles.

So, do in-wheel motors mean no friction brakes or a complex, problematic solution is required? No: it's another myth. We have developed a proprietary braking system that packages within the ProteanDrive in-wheel motor package and that meets all regulatory and operational requirements. ProteanDrive in-wheel motors are ready to deploy in series production passenger and light commercial vehicles. And we are working on several programmes with start-ups and established OEMs to bring in-wheel motors – and their several significant packaging, safety and efficiency advantages – to market.

#### About the author

Dr. Chris Hilton has been Chief Technology Officer at Protean Electric for over a decade.

These “Views from the CTO” provide an insight into the themes, thoughts and industry observations from an automotive technology CTO.



