Revolutionary multi-speed electric vehicle transmission substantially improves EV performance and range

Multiple ratios reduce battery drain and allow improved low-speed and high-speed performance

Prototypes of a novel, multi-speed transmission for electric vehicles (EVs) have begun on-road testing with a European vehicle manufacturer. Designed and manufactured by Italian drivetrain specialist Oerlikon Graziano with British control systems specialist Vocis, the simple, elegant concept will increase vehicle range or allow reduced battery pack size, as well as providing improved low-speed pull away and higher-speed cruising.

The wide operating range of a typical electric motor, which provides maximum torque from zero RPM, has led EV producers to use a single transmission gear ratio. Whilst reducing cost and packaging volume, the compromise is reduced efficiency and performance. “Electric motor efficiency drops off at low load levels and towards the extremes of speed,” explains Vocis technical director, Richard Taylor. “Multiple gear ratios with electronic control allow the motor to be kept in the region of greatest efficiency for a much higher proportion of the time, allowing significant range extension.”

The extra ratios also remove the compromise between top speed and hill-climbing ability. “An EV will typically have a transmission ratio that is higher than the ideal, simply to give it enough top speed,” says Taylor. “With multiple ratios, we can provide much better laden pull-away as well as improved top speed without increasing the powertrain size.”
The heart of the new transmission is a novel gearshifting concept based on principles similar to those used in a DCT, a transmission type in which Vocis has considerable expertise. Unlike most EV powertrains, which use a single e-machine (motor/generator), the Vocis multi-speed transmission works with two small e-machines, each on an independently-controlled shaft.

The design allows the distribution of drive and recovered energy to be balanced between the two e-machines, with seamless changing provided by torque infill during each shift. “The torque infill makes gearshifts so imperceptible that the first customer for the system asked to be shown that shifting was taking place because he couldn’t feel it when driving,” says Taylor.

Electronic control provides full driveline integration which, combined with multiple ratios, will also allow the implementation of alternative calibrations in order to tailor the feel and performance of the vehicle to the driver’s personal preferences or to match brand characteristics. It also provides the facility for strategies such as automatic ratio optimisation to maximise range.

Because the technology is readily scalable, including the number of ratios, it is easily applied to a diverse range of vehicles, as Taylor explains. “The priority for a passenger car application is to increase the performance to that of a conventional car by improving acceleration and top speed,” he says. “The priority for a delivery van would be to improve fully laden performance during pull away or hill climbing. And both will benefit from the significant improvement in range.”

Though more complex than a single-speed transmission, the cost and weight of the multi-speed system compares favourably to a conventional gearbox because it requires no clutch or synchronisers. This inherent simplicity makes the technology attractive to EV producers. “It’s possible that the additional cost could be more than recovered through reductions in the amount of batteries needed,” Taylor points out.

“Our two-speed transmission demonstrated the benefits of EVs moving beyond a single speed,” adds Vocis managing director Mike Everitt. “We are now extending those gains by using multiple ratios to make EVs more competitive in a variety of applications. This gives us single, twin and multispeed EV transmissions, all of which are already in running vehicles. We believe this to be one of the most comprehensive ranges available anywhere.”
About Vocis

Vocis is a world-leader in the design, development and calibration of automotive driveline control systems and in the management of complex driveline integration programmes. It's specialists have delivered some of the world's most demanding and prestigious transmissions at the leading-edge of power handling, refinement, packaging and efficiency. This expertise is also being applied to next-generation electric vehicles, where the company's innovative two-speed transmission will provide a step-change in energy efficiency. Vocis is part-owned by Oerlikon Graziano, which provides a considerable range of complementary skills, allowing the two companies to deliver complete, turnkey transmissions from design concepts through to vehicle integration and calibration.

About Oerlikon Graziano

Oerlikon Graziano is the world’s leading specialist in the design, integration and precision manufacture of transmissions for high-performance road cars. The company is also a leading global supplier of transmissions, axles and driveline components for other demanding sectors including electric, off-highway and industrial vehicles. With facilities in every region, including the USA, China, India, Italy and the UK, Oerlikon Graziano can support customers locally with an appropriate level of technology from single gears through to complete driveline systems and vehicle integration. All activities build on Oerlikon Graziano’s innovative approach to design, rigorous test and development and world-leading expertise in high-quality, low-volume manufacture.

Sales Enquiries

Vocis Driveline Controls, American Barns, Banbury Road, Lighthorne, Warwick, CV35 0AE, United Kingdom
+44 (0)1926 650308

www.vocis.co.uk

Photographs

Pictures are available electronically from the press agent or can be downloaded from www.autopresspoint.com
The red region shows the most efficient speed range for a traction motor. By keeping the motor operating in, or close to, this region, the new multi-speed transmission developed by Vocis could increase the range of electric vehicles with very little impact on cost.

Mike Everitt, managing director of Vocis Driveline Controls, believes the new multi-speed transmission will significantly improve the viability of electric vehicles.