

# transmission

Updates from Romax Technology

Issue 01



## PRODUCT NEWS Software Releases

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AND OTHER CUSTOMER UPDATES ON PAGE 5**



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# RomaxDESIGNER

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## USER FORUM & EVENTS



### Industry events

"Taking part in international trade shows and seminars is a great way to connect with existing customers, meet other industry professionals and tell the world about the latest technical advances Romax has achieved and new developments in the pipeline," says Xiaobing Hu, Chief Commercial Officer, Romax. The last 12 months saw Romax experts present technical papers at numerous events across the globe, including the NAFEMS World Conference, CTI Symposium China, CTI Symposium Berlin and the JSAE Annual Spring Congress – with more planned for 2016-17.



### Regional User Forums

2015 saw the return of Romax Regional User Forums, which took place in September and October in North America, France, China and South Korea. The theme running through all the forums was *Optimise: Your Roadmap to Smarter Driveline Simulation*, focusing on how innovation can help speed up and enhance design and development to drive down costs, reduce time to market and meet ambitious carbon emissions targets. Customers attending and keynote speakers included Fiat, Volkswagen, PSA Peugeot-Citroen, Volvo Construction Equipment, GM China, Osaka Sangyo University and Hyundai. The forums are a great vehicle to gather valuable feedback from Romax customers and to understand new and emerging industry requirements. With similar events planned for 2016, please look out for more details on the Events pages at [www.romaxtech.com](http://www.romaxtech.com)



## FROM THE EDITOR



Welcome to the first edition of Transmission. After talking to our customers, it was clear that a new magazine would be a very useful way to summarise and share news and developments in our business, the Romax software suite and our customers' experiences. Last year, we hosted a raft of events across the world, and a consistent theme was that our customers constantly face new challenges – along with new opportunities to embrace and, hopefully, profit from. We hope Transmission provides you with some additional insights into how you can achieve your business and technical objectives, whatever they may be. If you have suggestions for any updates, articles, or comments, please don't hesitate to get in touch with me.

**Rohini Syal, Editor - [transmission@romaxtech.com](mailto:transmission@romaxtech.com)**

## NEWS ROUND UP

### Andy Poon in Eureka magazine:

Interviewed by Eureka magazine, Romax CEO Andy Poon son of Dr. Peter Poon, reflected on Romax winning the BEEA Consultancy of the Year and Grand Prix awards: "Our job is to make sure that we can bring all the information in and create something that the designer can base decisions on - as soon as you do that, you can empower the designer with the freedom to do better and better designs." Read the full feature at [www.eurekamagazine.com](http://www.eurekamagazine.com)



**Dr. Peter Poon, Founder of Romax Technology - receiving award**



### 'Give designers more freedom' warns CTO

Barry James, Romax's Chief Technology Officer, has warned that pressure from legislators and consumers to develop a wider range of new powertrain and components more quickly and cheaply could have an adverse effect on quality. James spoke to *Automotive World* about the need to give designers more freedom and flexibility, plus the right tools so they can assess and select the optimum design options.



### Government funds for Romax R&D

Following a successful application, Romax has received an award from Round 3 of the UK government's *Regional Growth Fund* (RGF) to support continued development of leading computer-aided simulation software for automotive driveline and gearbox. RGF awards aim to help create new jobs, boost the economy and deliver new commercial opportunities in engineering.



### Romax HQ shortlisted for design award

The Romax Technology Centre (Nottingham, UK) was shortlisted in summer 2015 for the *Excellence in Design Award* in the commercial property awards operated by East Midlands Business Link. The £5.6 million environmentally-friendly facility at the University of Nottingham Innovation Park, which opened in 2014, features biomass heating, waste water recycling and a biodiverse green roof.



### Collaboration with UK university focuses on automotive fuel efficiency

A study by Romax and Loughborough University has revealed that fuel consumption in the automotive industry can differ by as much as 20% when comparing real-world drive cycles to rig and simulated tests based on legislative drive cycles, showing the significant variances that can exist. These findings are part of a three-year investigation, stemming from impending EU legislation that sets mandatory emission reduction targets for all new cars, into factors influencing energy consumption in hybrid electric vehicles. With PhD research student Matthew Lintern using a Toyota Prius, Romax and the UK's Engineering and Physical Sciences Research Council jointly funded the project.



### Partnership with India's Inox Wind reaches 500th gearbox order

Indian wind turbine manufacturer Inox Wind has placed a milestone 500th order for Romax-designed two-megawatt wind turbine gearbox. With India developing into one of the world's fastest growing economies in the last few years, wind power now accounts for almost 10% of installed capacity and generates 2% of the nation's power. "We have worked closely together with Romax for six years – starting with gearbox design and then ensuring that high production standards are maintained and type certified across our suppliers," said Mr. Kailash Tarachandani, CEO, Inox. "Choosing the right long-term partner has provided us with a stable platform to grow in the renewable market." *Read the full press release at [www.romaxtech.com](http://www.romaxtech.com)*

### Korean marine transmission firm delivers innovation for customers

D-I Industrial is South Korea's leading manufacturer of hydraulic marine transmissions and speed reducers, steering systems and power take-offs. With the company aiming to exceed the expectations of demanding customers worldwide, D-I Industrial uses Romax software in critical areas including root cause analysis, gear whine reduction and general design optimisation. Romax consultants have also performed a root cause investigation on gearbox and recommended design improvements. "The most important benefit of Romax software is the ability to reduce the time it takes to locate design errors, thanks to the advanced simulation capabilities," said Junseong Kim, D-I Industrial R&D Centre. *Read the full case study at [www.romaxtech.com](http://www.romaxtech.com).*



### USA: supporting 'an essential national resource for wind energy'

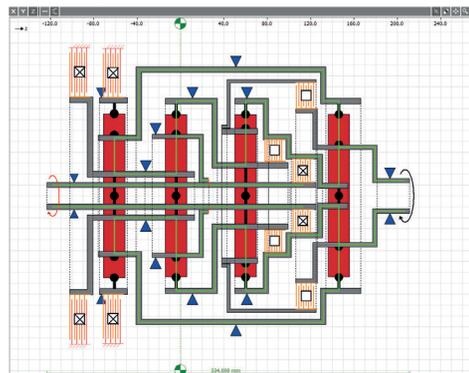
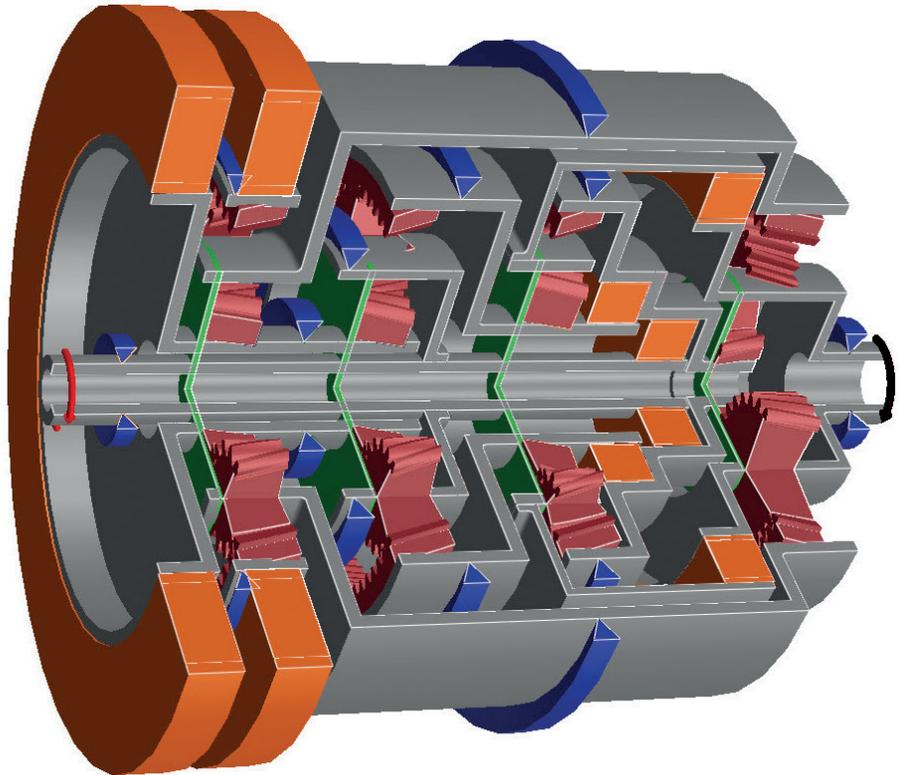
Romax's relationship with the USA's National Renewable Energy Laboratory continues to deliver benefits. The US Department of Energy's main national laboratory for R&D into renewable energy and energy efficiency, NREL operates a 327-acre main campus and 300-acre National Wind Technology Center in Colorado. Romax provides a local hands-on presence and the flexible delivery of simulation, instrumentation and design expertise, with software and consulting supporting R&D in multiple areas, including the Gearbox Reliability Collaborative that brings together manufacturers, owners, researchers and engineering experts to recommend efficient and cost-effective improvements in the gearbox lifecycle. Romax is delivering innovative drivetrain designs with an increased understanding of gearbox failures and enabled improvements in industry design practices.



## Reliability-based design optimisation for Volkswagen AG

*Europe's biggest carmaker aims to optimise product quality and make manufacturing more robust*

Engineers at Volkswagen's Kassel site, which supplies almost four million manual and automatic transmissions every year, have used Romax software for over four years. "Romax provides the ability to look at the whole system, rather than individual components alone," says Juri Kniss, Calculations Engineer, "We can assess the effects of gear manufacturing variability within a fast and accurate simulation." For example, engineers use Romax to analyse designs and assess how the tolerance variability of gear microgeometry will impact on NVH (Noise, Vibration, Harshness) in a finished gearbox - "integrating rapid modelling and analysis of gears, shafts, bearings and housings within a single gearbox model to predict how components interact." In another project, Romax was used to analyse the fit between motor stator and gearbox housing to predict housing deformation and its effects on gears and bearings: "We took the misalignment predictions and passed them to our colleagues in Wolfsburg to support optimisation of the gears, so they could apply this to calculate new micro geometry, to reduce noise and improve durability."



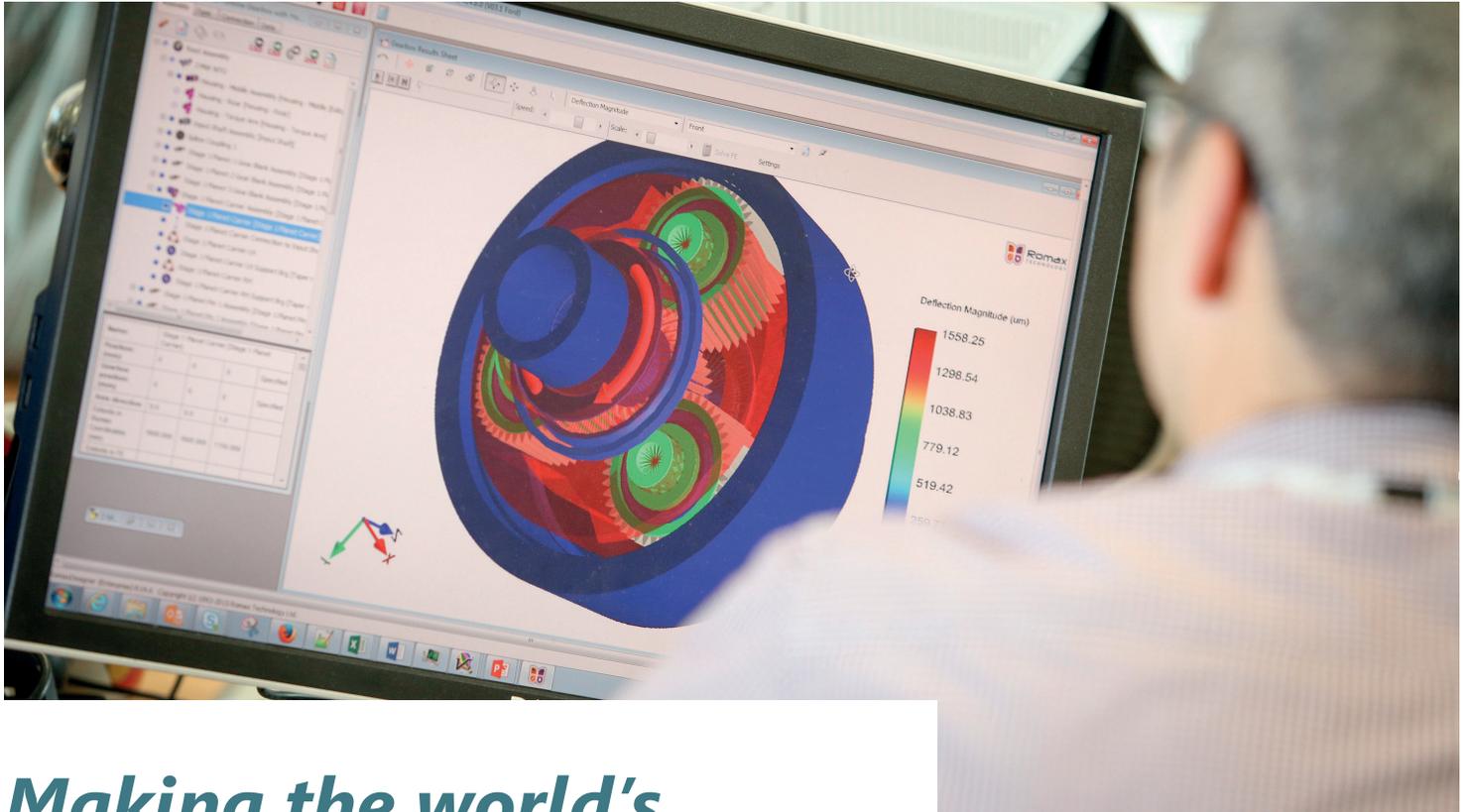
**HYUNDAI**

## Hyundai WIA uses agile development for gearbox simulation model

*Faster, more focused and lower cost development of high-tech products*

Part of Hyundai Motor Group, Korea's Hyundai WIA products include engines, four-wheel drive parts, manual gearboxes, six-speed dual clutch transmission, half-shafts, chassis modules, reduction gears for electric and fuel cell vehicles, and electric couplings. To streamline and enhance design and development, teams across Engineering, Testing and Control Logic Development all use **RomaxDESIGNER** and **CONCEPT** software. Senior research engineer Kisung Lee says Romax "helps decrease development time and helps in minimising design failure; we can make products more robust at an earlier stage. Internal customers want to receive complete development parts, not a developing one. So Romax is extremely helpful to design *Right First Time*<sup>™</sup>, including both part optimisation and process optimisation. Time and cost savings with great results are the main reasons we use Romax." The company plans to use the software to create future products including a new-type speed reducer for next generation Fuel Cell Electric Vehicles plus industrial machine gearboxes – across the entire process from concept design and assessment, and covering both gears and bearings: "For gear design, Romax is the most effective and powerful package I have ever used."

**Want the bigger picture? Read the full stories at [www.romaxtech.com](http://www.romaxtech.com)**



# Making the world's leading CAE simulation software even better

**User-driven updates, enhancements and additions to RomaxDESIGNER, CONCEPT and CAD FUSION software are now available.**

"These software releases are all about listening and responding to customer feedback," says Jamie Pears, Software Product Manager. "In our efforts to continuously improve the software, this input from customers is a critical element. Our products must be user-driven and market-focused so that Romax customers can innovate and achieve more." Working closely with customers over the last few years has led annual software updates to ensure the Romax software suite, with RomaxDESIGNER at its heart, is constantly evolving.



**Dr. Jamie Pears**  
Product Manager

*"These new releases enable process improvements and design optimisation at every stage of the design and development process - helping designers, analysts and engineering managers to work even faster and more effectively."*

### Product releases: highlights...

- Batch Running: leverage investments in Romax analysis by linking to other CAE tools and optimisation platforms
- Improved CAD interoperability, including the ability to import complex 2D or 3D shapes such as planet carriers and differential cages, from any CAD package
- New capabilities to build 3D solid geometry using an intuitive direct modelling approach and then automatically create an FE mesh, removing the need for 3rd party CAD and FEA packages
- New and improved components: Worm, face and beveloid gears, detailed spline analysis, improved planetary modelling
- General improvements and enhancements across RomaxDESIGNER, CONCEPT, CAD FUSION and Dynamic FUSION software, including improved usability and Windows 8, 8.1 and 10 support

## PRODUCT NEWS: SOFTWARE RELEASES



"The software not only reflects customer demands, it's also an integral part of how Romax itself works," Pears adds. "Rigorous testing ensures it is ideally suited to our customers' requirements as well as meeting the demands of our in-house engineering teams. Our own design and consultancy practices, often working on world-class projects, depend on the software in exactly the same way as our customers." Watch our new releases webinars at [www.romaxtech.com](http://www.romaxtech.com) and see the full capabilities in more detail. One to one training with our account managers is also available.

*"RomaxDESIGNER sits at the heart of our design process, and already saves us a lot of time in the development cycle. The new Batch Running capability has brought us even more convenience and time savings. We look forward to continuing to use it and integrating it into our processes, and to see what Romax has in store for next year,"*

**Berk Yavuz Ozberk, GETRAG.**

### Batch running adds powerful new dimension

This new functionality automates transmission and driveline analysis using third party tools for an even faster and smoother process. It builds on the software's existing productivity and openness to automate and integrate the running of Romax analysis with external scripts and third party applications such as Isight and Optimus, empowering teams to achieve more and design smarter.

### Create flexible bodies earlier - streamline model creation

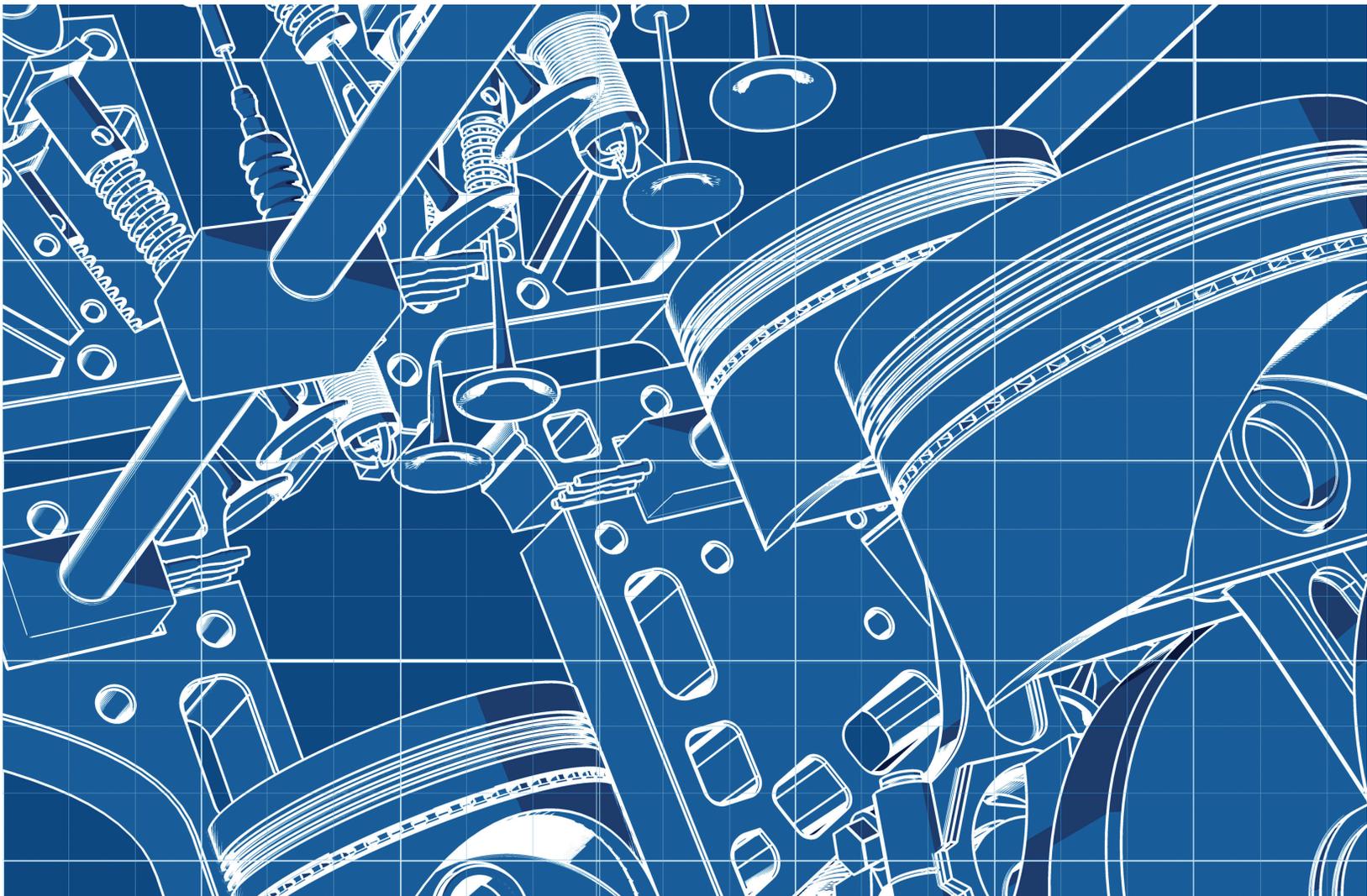
3D Component Creation & Meshing enables you to work with complex shapes without using any external CAD or FE tools, achieving world-class gearbox structural analysis and optimisation capabilities. Users can combine detailed nonlinear component models such as gears and bearings with imported FE structures representing housings, planet carriers, differentials and other components.

### Andy Poon, CEO, Romax Technology, writes:

"Romax is already the preferred solution in many organisations for drivetrain and gearbox design, with manufacturers also increasingly using our software as the backbone of the entire transmission design and analysis process. These updates provide new routes to design optimisation, with even smarter and faster ways to analyse, design and optimise gearbox, bearings and driveline. With new features and enhancements based on feedback and wishlists from customers, gathered and assessed by our R&D teams, we are aiming to help our customers achieve even more - whether they are working in automotive, aerospace, rail, off-highway, renewable energy, or any other sector that depends on high-performance and highly reliable cost-effective drivetrain and gearboxes. As a business, we are committed to continuously improving our industry-leading simulation, modelling and analysis technology. And this commitment to innovation, to pushing forward the boundaries of what's possible, is increasingly recognised. For example, we were particularly proud to not only be named Consultancy of the Year at the British Engineering Excellence Awards in 2014, but Romax also received the overall Grand Prix award. Why? Because the judges recognised our year-on-year commitment to innovation, and the serious time and effort we put into applying new technologies within the engineering space, and for customers across the globe. These new releases continue and reinforce that commitment".



**Andy Poon**  
Chief Executive  
Officer



## *A sound approach: driving success by analysing NVH earlier in the drivetrain design process*

**Taking a smarter look at noise, vibration and harshness earlier and as part of a 'whole-system' approach can help you optimise product quality, avoid costly problems later, and speed up time to market.**

The Serbian-American engineer, physicist and futurist Nikola Tesla (1856-1943) said: "If you want to find the secrets of the universe, think in terms of energy, frequency and vibration." The challenges involved in unlocking those secrets, however, will be familiar to any NVH engineer that's trouble-shooted a transmission or axle gear whine problem during the launch phase of a new vehicle. Such exercises often begin with "ear to gear" engineering implemented while driving a reportedly noisy vehicle. The

response of a gear design or NVH engineering team is often trying every countermeasure that's worked before, as quickly as possible, one at a time in a linear fashion. Such behaviour is commonplace when dealing with passenger compartment gear whine.

For some time, it seemed like managing such gear whine had reached a certain level of containment. Road, wind and internal combustion engine noise provided just enough masking,

vehicle structural and acoustic sensitivities were properly managed, and high quality gears were manufactured so tonal noise from transmission and axle were barely perceptible. Major OEMs were grinding gears specifically for controlling quality, while most gear engineers understood that high levels of transmission error equated to passenger compartment noise. Automotive companies were willing to invest in higher levels of sound packaging for vehicles, and engineering chassis to be less

compromising gear quality. If this is the current landscape, then what options are open to today's designers and engineers to have a real impact on NVH? How can you identify then practice the optimal processes required to understand, manage and reduce gear whine?

### Towards an ideal design process to tackle gear whine

The "voice of the customer" should be factored into the design of all consumer products, including the noise performance of transmission and axles, and with other performance attributes such as durability, efficiency, cost and weight. In this case, a Quality Function Deployment (QFD) approach is useful to visualise how gear micro-geometry, for example, could be directly linked to subjective passenger compartment gear whine. An allowable variation in passenger compartment subjective ratings could translate not only into gear macro/micro-geometry design targets, but also allowable manufacturing variation for the gears. In practical terms, the voice of the customer should be used to help a manufacturing team decide between rolling, shaving or grinding gears.

If using a source-path-receiver (SPR) model for gear whine, the customer-derived tonal noise targets fit well into the "receiver" category. Managing the "path" is equally as important as managing the "source". Simplistically, for an automotive transmission the "path" is represented by the transfer of forces from the gear mesh through

shafts and bearings, ultimately causing the transmission housing to vibrate. Likewise, another "path" follows the forces from the vibrating transmission system through the various structure-borne and airborne paths of the vehicle, eventually arriving in the passenger compartment. This path from the transmission system to the passenger compartment is often quantified by performing a noise path analysis (NPA), also referred to as transfer path analysis (TPA).

QFD, SPR and NPA/TPA can in fact be applied to any product in any industry, from wind turbine gearboxes to agricultural axles or helicopter gearboxes, and the list of products demonstrating gear whine is endless: from household appliances and power tools to buses and construction equipment.

The second and final part of this article in the next issue of Romax Transmission discusses the best approaches in terms of gearbox design optimised for NVH - in particular, experience-based approaches versus advanced computer-aided engineering software used upfront - as well as Troubleshooting, and some Basic Guidelines to get started in creating optimum models.

*This article is based on a forthcoming Romax white paper at [www.romaxtech.com](http://www.romaxtech.com)*

sensitive to gear mesh forces. So what's the problem?

In part influenced by the economic downturn and environmental pressures, the refinement of tonal noises in passenger compartments has suffered in recent years: reduced investments in sound packaging; inexperienced NVH engineers after mass retirements in the skilled workforce; alternatives to IC engines including electric vehicles and hybrids that reduce engine masking; and a slight shift away from expensive gear grinding operations, perhaps

**Our all new Romax Solutions Catalogue is coming soon.**

More news and a full preview in the next edition of Transmission.



*"To meet increasing customer expectation and faster development cycles, GKN Driveline has to get 'Right First Time'™ to the required product performance, and Romax helps us achieve that"*

**Theo Gassmann,  
VP Advanced Engineering**



**GKN DRIVELINE**

### **GKN Driveline improves gearbox efficiency without sacrificing NVH and durability**

With the rise of electric vehicles and hybrids having a significant impact on automotive engineering, the world's leading manufacturer of automotive driveline components is applying Romax software and expertise to help optimise gearbox efficiency.

The challenge is to create more powerful and efficient transmission for greener electric-drive vehicles, enabling GKN Driveline to capitalise on new market opportunities, but without making trade-offs in durability and NVH (noise, vibration, harshness). "Genuinely high-performance products demand the effective application of system know-how from concept to production, so you can find the best possible balance," says Theo Gassmann, VP Advanced Engineering. The company has been working with Romax for over 10 years.

### **A 'whole-system approach' to design optimisation**

Conventional methods to increase efficiency can have adverse effects on durability and quiet running, with reduced engine noise in EVs rendering many design practices unacceptable. The pressure on GKN Driveline to improve eDrive gearbox efficiency in all-wheel drive hybrids demanded a fresh approach. "We saw the value of analysing the whole system, to identify where the greatest benefits could be gained, then working to balance efficiency, durability and NVH across the entire system," explains Dr. Artur Grunwald. Romax software provided the accuracy demanded in modelling and analysis, while working with Romax people on a project and consulting basis enabled GKN Driveline "to learn how to best use the software and apply our engineering expertise. We use **RomaxDESIGNER** for problem solving and system optimisation from concept to production design... it shows where you can have the most impact and where the benefits lie. It's one of the few software systems capable of this

type of system analysis. Our goal is, systematically, to separate the useful parameters from the possible in order to enable the biggest benefit at acceptable cost level."

Romax's abilities to boost efficiency were tested in a project that involved an eDrive gearbox connecting an electric drive to the rear axle of a PSA Peugeot Citroen passenger car, with a conventional IC drive connected to the front wheels. After identifying the main contributors to power loss, investigating how changes to macro- and micro-geometry would affect efficiency, and optimising the geared system, GKN Driveline manufactured improved gears and evaluated driveline efficiency. Results showed improvements across the speed and torque range of interest of up to 2% without compromising on durability and NVH – providing valuable insight into how GKN Driveline can drive continuous performance improvements in customer applications.

*Read a longer version at  
[www.romaxtech.com](http://www.romaxtech.com)*

## How can you engineer innovation into driveline design?

**Dr. Michael Platten says thinking differently and taking qualified risks can help iron-out problems earlier, reduce costs, speed up time-to-market and deliver higher quality products.**

Innovation is often synonymous with the use of new or novel technologies and methods to achieve design and development goals, delivering higher quality products in faster, more efficient and lower cost ways. While most methods gradually improve over time, making a major leap forward requires a different mindset: stepping outside your comfort zone because true innovation implies risk. The big issue is how to minimise those risks and profit from constant improvement, driven by innovation: the lifeblood of successful high-performing operations.

From an engineering perspective, three core requirements need to be met. Pressure for faster, lower cost development – ‘cost reduction and faster time-to-market’ are the mantra: shorter and cheaper development cycles mean less time to work and increased pressure to “get it right”, eliminating mis-steps and arriving at viable design choices sooner. Customers want more at lower cost - consumers expect higher performance, more features and smaller footprint for the same or less money. In general, design performance is measured by whether it meets certain targets/specifications while avoiding failure modes. Inevitably, design targets and product criteria will conflict. While previous experience and incremental improvements continue to play a role in designing “conventional” drivelines,

new concepts don’t have a track record of accumulated successes and failures. Novel designs can have very different performance targets, component/material demands and failure modes. New concepts suggest more risk, meaning greater dependence on timely, accurate, trustworthy simulations.

A basic way to mitigate “innovation risk” is formulating a robust plan with realistic (although challenging) targets to measure new developments against, plus regular reviews of technological readiness to understand and control costs. Using the right tools and methods is critical: as tools and methods evolve, design processes need to adapt to make use of them, so a designer or engineer can quickly and confidently assess multiple options and decide if a new idea has merit. To wrap this up, here are four pointers to start engineering innovation into design.

### **1. Simulate early, simulate often**

– having the ability to quickly rule out designs destined for failure is the most efficient way to innovate, while adhering to certain principles driven by engineering realities and the challenges of innovation itself.

**2. Fast to build, fast to solve** – aim to get concepts and ideas from brain to model as quickly and easily as possible, and run simulations fast: you want to learn if an idea’s workable with minimum investment.

### **3. Accuracy versus precision**

– simulations need to be as accurate as necessary, not as precise as possible. There’s no point building very detailed models or using complex analysis methods too early; use simple models/methods then move to smarter simulations.

### **4. Provide engineering insight for engineering questions**

– simulation tools should not only provide masses of results, they should also give pointers on what to do next, distilling results into actionable insight and helping you focus on what really matters.

*This article is a summary of a Romax white paper by Dr Michael F Platten BEng PhD, Product Manager – Dynamics and Noise and Vibration Specialist.*

*Read the full white paper at [www.romaxtech.com](http://www.romaxtech.com)*



**Dr. Michael F Platten**



### Investigating bearings - Iarnród Éireann Irish Rail

Carrying 40 million passengers annually, Iarnród Éireann Irish Rail is Ireland's national railway operator. When it began experiencing a rising number of bearing failures in a relatively new fleet of diesel multiple units, it wanted to identify the cause. "It soon became evident that an independent external view was required to get to the root cause of the problem," says Damien Lambert, Technical Support Manager, Bogies and Wheel Sets. The double row taper bearings should provide a service life of three million kilometres but some were failing at 750,000km: the highest failure rate on any bearing in this fleet. Not catastrophic failures, Lambert says, but an unacceptable percentage could not be overhauled - with obvious cost implications: "We needed substance in the findings so they could stand up to scrutiny. That's what Romax provided." Romax consultants and engineers conducted a detailed yet cost-effective investigation, using their deep domain knowledge of bearings and gearbox allied with high-performance simulation software. "Romax not only had the resources and technical expertise, it was all managed in a comprehensive and even-handed way," Lambert says. "Another important point was Romax's ability to tailor the work for us, including financial constraints. They were very flexible." This rapid impartial investigation helped Iarnród Éireann Irish Rail to better identify the cause of failure, providing robust findings so it could move ahead with plans to optimise rolling stock, protect operations and reduce risk.

### Expert services and industry-leading tools for Rolling Element Bearings

*A growing number of organisations are looking to Romax for its expertise in bearings and the systems that use them. Chris Halse, Head of Engineering Services, explains why.*

Romax services are proven in the field and, when it comes to bearings, our approach covers all bases. First, our deep experience enables us to deliver strategic consulting, which can include market entry studies and supplier assessments. Second, our extensive technical support services include design and simulation, manufacturing audits, metallurgy, production implementation, rig testing and failure investigation. Third, we also offer application engineering including design and simulation for gearbox and other bearing system – and sectors including automotive, aerospace, rail and renewable energy – plus bearing selection, and manufacturing/assembly audits. Crucially, we also deliver technology transfer, including training on all aspects of bearing theory, simulation and application. Of course, **RomaxDESIGNER** is also now acknowledged as the leading independent software for system analysis of rolling bearings, with key technologies including deflection analysis for all significant ball and roller bearing types, as well as contact load, stress, contact angle and ellipse truncation, including the effects of misalignment, clearance and roller micro-geometry, and with life calculations to international standards. You can look at stiffness in multiple ways, include the effects of fastener clamping loads on bearing load distribution, calculate contact stress due to edge loading of rollers, and more. You can even share models securely with bearing suppliers. For these and many other reasons, Romax is leading the way in bearings solutions.

Visit [www.romaxtech.com](http://www.romaxtech.com) for the full case study and on-demand bearing solutions webinars.



Dr. Chris Halse



## Japan: trends in the automotive industry

“The most prominent trend is a push for more environmentally friendly cars, as the Japanese government has put out many incentives for both manufacturers and customers,” says Chris Blockley, General Manager, Romax (Japan). “Hybrid cars are also up-and-coming. Efficiency comes under this, too; many customers are looking for more efficient vehicles.” He says a key issue is improving gearbox, bearing and driveline designs for EVs, hybrids and more energy efficient vehicles in general, as leading companies including Honda, Mazda and Isuzu pursue more environmentally friendly engines. “In this challenging development environment, simulation is extremely important: to provide comparisons with existing powertrain systems and for trial-and-error testing, while offering powerful interfaces to other software tools - all focused on delivering results. R&D projects using Romax software have already been proven to deliver environmentally friendly, highly efficient technology engineering solutions.”

Mazda provides a good example of how Romax is being applied in the industry: “We’re expected to achieve the optimal balance of environmental performance, safety performance, and pleasure in driving,” said Mr. Takashi Miyamoto of Mazda’s Engine Performance Development Department. “That’s challenging itself - and even more so because Mazda sets its goals at higher levels. Innovation in products is extremely important to us, and Romax helps Mazda to achieve that: to provide more accurate and effective optimised designs faster, and therefore at lower cost... we can make calculations under various conditions, so we know our products will have robust performance, and using **RomaxDESIGNER** in our SKYACTIV transmission project means we have seen substantial improvement in fuel economy.” He describes the software as “an irreplaceable tool in the design process, enabling us to develop the new range of transmissions quickly, accurately and with confidence.”

Chris Blockley adds, “We can provide our customers with a fully integrated solution that can be used as a ‘master model’ for all design and development. Our solution is the keystone, in the sense that it can be the central element in a much bigger process - one that ensures all the other elements fit into place, and therefore is what enables the entire process to succeed.”

Read the full Mazda case study at [www.romaxtech.com](http://www.romaxtech.com) - ‘Irreplaceable’ Romax enables innovative transmissions with improved fuel economy and robustness.

### Automotive trends in Japan

- Government subsidies encourage the purchase of next-generation clean energy vehicles; earlier tax incentives have included exemptions for EV, plug-in hybrids, clean diesel and natural gas vehicles.
- Leading manufacturers are actively pursuing more environmentally friendly engine designs, aiming for progressively cleaner exhaust emissions, and compromising on...
- Efficiency, which has been rising up the agenda.
- Many initiatives are under way to develop lower-pollution vehicles, including using alternative energy sources and hybrid systems.
- However, there is also recognition that because diesel engines combine excellent performance, durability, fuel efficiency with relatively “low” carbon emissions, they also have huge potential.

*“Romax**DESIGNER** has brought a great contribution to our business because it’s fast, accurate and robust, performing optimisation quickly and efficiently.”*

**Mazda**

Romax in Japan is based in Tokyo: Romax Technology, Oomori YS bldg. 5F 3-22-7, Minami-Ooi Shinagawa-ku, Tokyo 140-0013. Tel: 0081 (0) 3 5767 9400



Chris Blockley



### Improving noise performance in EVs and hybrids with switched reluctance motors (SRM)

*Barry James, Chief Technology Officer at Romax, explains how a more innovative approach to simulation and modelling can help you to design quieter, more efficient greener cars for a mass market*

Calls to reduce emissions have incentivised automotive companies to approach mass production of electric vehicles (EVs) and hybrids seriously. Mass sales can only be achieved, however, if such vehicles have a wide appeal to consumers and satisfy all quality criteria consumers expect. The problem is, with EVs far quieter than internal combustion vehicles, noise performance and wider NVH issues come to the fore. In the last year or so, we have gained valuable experience in simulating and reducing noise in an EV powertrain using a switched reluctance motor (SRM). Our methodology meant we could look at the entire powertrain: modelling dynamic properties as a whole-system, subjected to motor excitation (torque ripple, electromagnetic forces and rotor imbalance). Our approach was also characterised by the rapid speed of modelling, with analysis and data interpretation taking place early enough in a project so effective steps could be taken to reduce noise. This contrasts with the typical approach of simulating problems that have already occurred in testing.

Why SRMs? The price volatility and supply uncertainty of rare earth material means approaches based on Permanent Magnet Synchronous Machines (PMSMs) are less attractive for mass production. Companies want more cost-efficient technologies such as SRM to mass-produce motors cheaply, while running a motor at higher speeds allows greater power density, giving lower weight, smaller motor and lower overall cost. However, SRMs actually display worse vibro-acoustic behaviour than PMSM. Waveforms are non-sinusoidal, meaning SRMs have extremely high harmonic content compared to standard rotating field machines. The radial forces that largely cause stator vibration are strong, as torque is produced by reluctance force and not Lorentz force. Harmonic frequencies are proportional to speed, with high rotational speed making low order harmonics hit the structural resonances earlier. Moreover, today's reality is that vehicle OEMs tend to rely on component suppliers to design, test and manufacture sub-systems, which are assembled into a vehicle. Suppliers may design and develop "quiet" sub-systems to what are considered "state-of-the-art" levels, only for the vehicle OEM to find the assembled e-powertrain is unacceptably noisy.

How can these various issues be resolved in the most effective way? CAE tools for simulation and modelling should provide the answer. Problems arise, however, in the way such tools are currently applied, their underlying functionality, and the point in development at which they are used. Our approach, we believe, solves these issues.

*Read the full white paper at [www.romaxtech.com](http://www.romaxtech.com)*



**The second part of this article in the next Transmission will discuss how we need to rethink simulation and modelling with a fresh approach - and the benefits to be gained.**



**Dr. Barry James**

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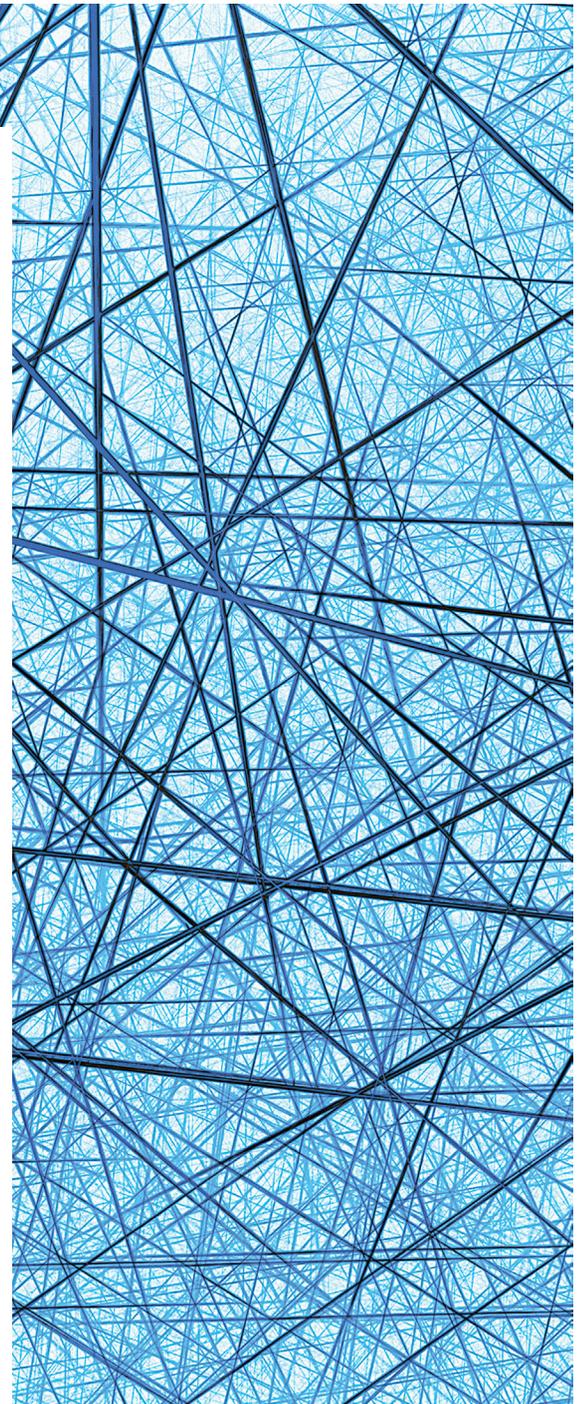
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- **Optimising Designs at Planning and Concept Stages** - gaining the ability to reveal, explore and resolve issues far earlier, balancing multiple criteria and requirements for more informed decision-making on the options available.
- **Engineering Innovation Into Driveline Design** - thinking differently and taking qualified risks can help you iron out problems earlier, reduce costs, get to market faster and deliver higher quality products.
- **Improving Noise Performance in Electric and Hybrid Vehicles** - simulating and reducing noise in an EV powertrain using a switched reluctance machine. How powerful analysis tools and creating the right model at the right time mean you can systematically target noise reduction during the design process.



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## AND FINALLY

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### Honorary degree for Romax founder

Dr. Peter Poon MBE, founder and president of Romax Technology, received an honorary degree of Doctor of Science from the University of Nottingham in December 2015. Vice-Chancellor Professor Sir David Greenaway said, "Romax Technology is a world class business and a significant local employer, and Dr. Poon has always valued the partnership that his company has with the University... our links with the company are stronger than ever." Dr. Poon's honorary degree recognised his sustained commitment to driving innovation. In June 2014, Romax moved its world headquarters to a new £5.6m state-of-the-art building at the University of Nottingham's Innovation Park. The company has also undertaken Knowledge Transfer Partnerships with the university, collaborated on major research projects, and provided placement and full-time employment opportunities for students. *Read the full news article at [www.romaxtech.com](http://www.romaxtech.com).*



Dr. Peter Poon

# *Solutions for gearbox, transmission and driveline designs...*



Romax Technology's simulation software and services support automotive and off-road OEMs to optimise final design performance within transmission and driveline engineering. We help you to work smarter and faster at reduced cost, and be more competitive.

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