Accelerating automotive design development

SIEMENS

White Paper

How enhancements in CAD technology are influencing vehicle design

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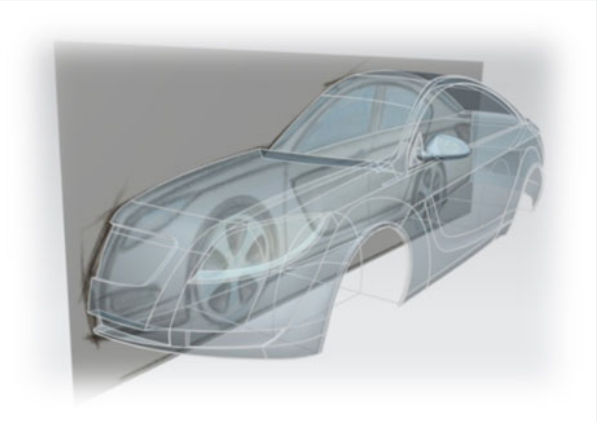
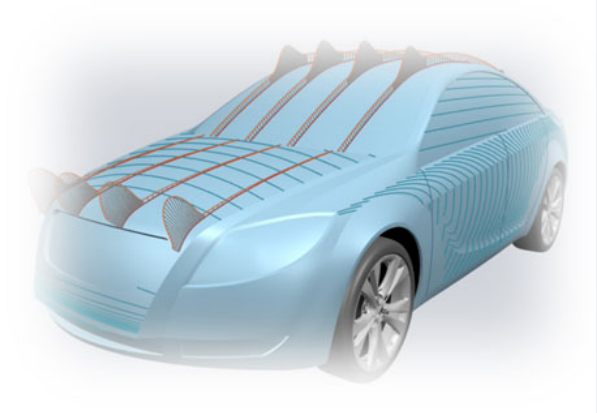
Executive summary

Today's consumer is better informed, more discerning and very product savvy. Furthermore, with vehicle price, performance and perceived quality on a virtual level playing field (per sector), design has never been more critical to success. However, design is fashionable – it's ever changing and evolving – which puts automotive manufactures under continuous pressure to meet the demands of the customer and get products to market faster. To do so, vehicle designers require tools that enable them to rapidly explore ideas, reuse knowledge, optimize concepts and visualize and validate designs from ideation through production; all within a collaborative environment that facilitates informed cross-functional decision making and ultimately accelerates the global vehicle development process.

Design to requirements

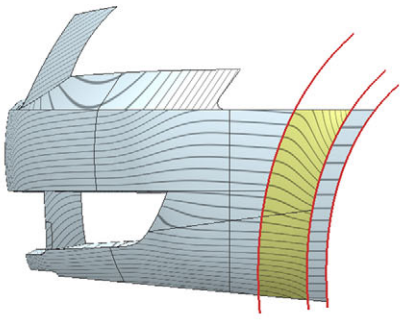
Vehicle design is an iterative process. As designs develop – from concept sketch to clay model, through theme selection and onto production surfacing – so the "master" model shifts from the physical to digital with continuous, changes and refinements to the vehicle form. Throughout the process, feasibility matures, the vehicle package is optimized and the design is continuously validated against engineering, manufacturing and legal requirements. To expedite this process, tools such as NX™ software from Siemens PLM Software provide knowledge-based engineering templates to enable designers and studio engineers to explore vehicle architecture and packaging configurations to rapidly progress designs from ideation to feasible concepts while simultaneously taking into account the voice of the customer.



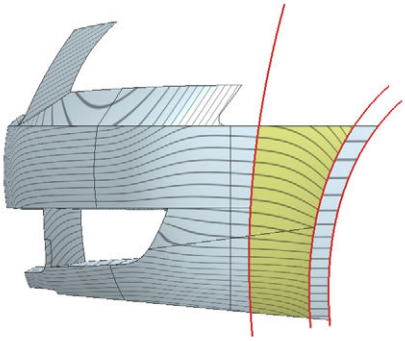


Hybrid modeling

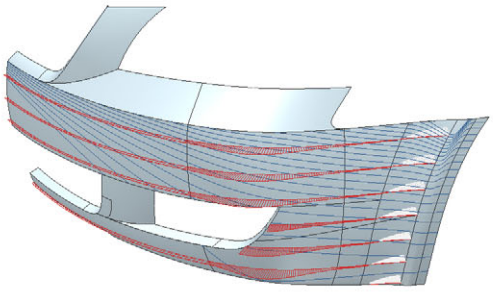
Since the inception of 'flame' surfacing by Chris Bangle in BMW's X Coupé concept car in 2001, vehicle forms have become increasingly evocative. Sharp feature lines are now prevalent across the industry, adding tension to surfaces and providing a sense of motion (even when the car is stationary). To create such complex organic forms, NX supports a hybrid modeling philosophy and provides comprehensive tools to deliver the design intent (design language or DNA) including reverse engineering (facet handling and rapid surfacing), curve-based (sweeping/lofting/meshing), freeform ("control point" editing), surface solids (2D sketch derived geometry for creating textures e.g. grilles and vents) and global deformation (global modeling by surface or function). For conceptual workflows, multi-segment NURBS (non-uniform rational B-spline) data can be used to reduce the surface count – providing increased flexibility to accelerate 3D concept creation. Freeform commands offer embedded design "sculpting" and curve/surface rebuild controls for Bezier (single span) output, affording the superior control required for class-A surface refinement. Utilizing hybrid modeling ensures the digital sculptor is never limited by the software but rather has the flexibility to select the most appropriate tools for the task in hand.



An Offset Curve is used to create the initial wheel-arch 'eyebrow' surfaces.



When the Offset Curve is modified, the 'eyebrow' surfaces update accordingly.

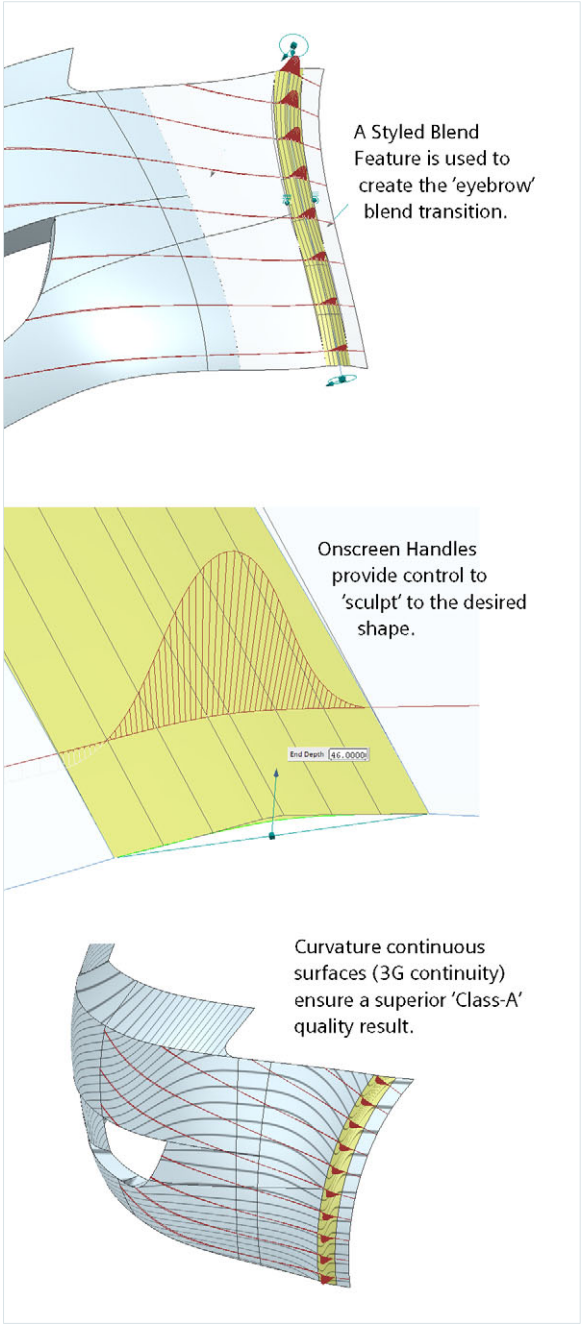


Change propagation speeds model creation and modification to deliver the 'Design Intent'.

Change management

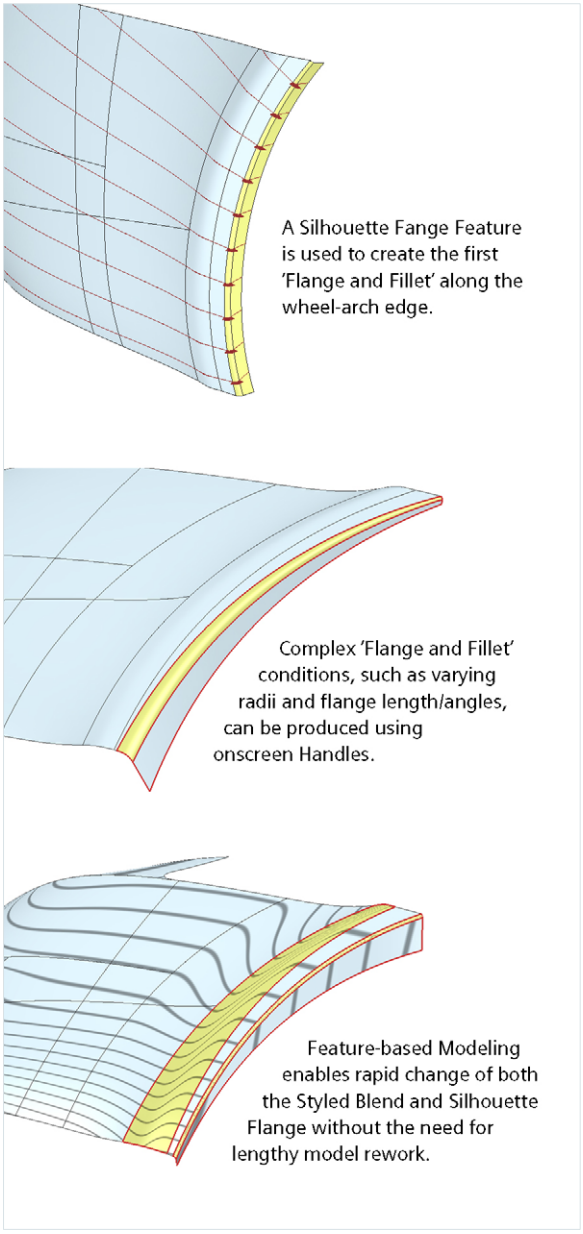
Class-A surface geometry is typically created on specialist stand-alone software. This presents a challenge when exchanging data with downstream recipients (in the organization). Data translation issues can result in changes to carefully crafted surface forms, potentially requiring rework, or worse, going unnoticed. Such specialist systems are usually explicit, requiring the user "delete and recreate" geometry when the inevitable change occurs. For years now mechanical engineers have used parametric software (storing commands as features in the part's history) to enable rapid creation and modification of geometry via rules (or parameters). Realizing the benefits of this approach, NX brings feature-based modeling to freeform design. Now digital sculptors can readily accommodate change affording designers freedom to rapidly explore concepts and iterate themes.

In addition, NX uses associative constraints (rules such as tangency or curvature continuity) and parameters (values such as length or radius) to control geometry. Values can be adjusted and features added, and the geometry updates accordingly. When combined, features, parametric inputs and associativity enable rapid change propagation and can significantly speed both create and modify workflows. Furthermore, features provide the ability to evaluate the cause and effect of change (to geometry) throughout the design process; be it positioning surface boundaries during initial creation, or surface highlight refinement in the production design phase. Most importantly, NX harnesses the power of feature-based parametric modeling and delivers it in a serviceable fashion providing flexibility for digital sculptors to work explicitly or feature-based "on-demand."



Collaborative engineering

In order to speed development, cross-functional teams must collaborate effectively and work concurrently. Early visibility of design data (by the wider organization) can reduce design iteration and facilitate smooth progression through development gateways. By utilizing NX, multiple body engineers are able to work in parallel on the same part file to simplify creation and modification of complex body-in-white (BIW) panels. Knowledge is easily captured and reused via product templates, user-defined features (UDF's) and rule-based wizards for recurrent engineering tasks such as calculating stone impingement, tire envelopes and hinge locations. Furthermore, template parts promote concurrent engineering best practice by enabling body engineers to replace class-A surface data (typically used to construct BIW panels) with the latest surface revision, and the associated BIW panel geometry updates accordingly.



Validate for production

Throughout design development, geometry is continuously validated to ensure the myriad requirements are satisfied without compromising aesthethic integrity. NX delivers comprehensive visualization and validation diagnostics within a visually engaging environment providing high definition decision support throughout the process. During creation, the digital sculptor continually analyzes surface aesthetic properties (curvature graphs, highlight and reflection lines) and technical criteria (engineering, manufacture, quality and legal), while maintaining proximity to reference facet data (scanned clay model). In addition, the sculptor supports the review and sign-off process, creating animations, renderings and digital models for “design time” appraisal, optical appearance (craftsmanship), color and trim, cubing and formal design reviews. With ever greater emphasis on perceived quality, real-time rendering realism is imperative in order to validate designs for production. NX leverages global illumination (high dynamic range image-based lighting and reflections), soft shadows, inter-object shadows, ambient occlusion, multi-layer paint materials and RTT environment scenes, within an easy-to-use interface for rapid model preparation.

Conclusion

Increasingly OEM's are looking to consolidate product lifecycle management (PLM) to exploit the benefits of a single system solution – collaborative, concurrent engineering with seamless data transfer and no loss of data or model rework. NX supports the end-to-end design process and leverages hybrid modeling, knowledge reuse and template solutions to help accelerate development and bring better products to market faster.

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 7 million licensed seats and more than 71,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with companies to deliver open solutions that help them turn more ideas into successful products. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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