PowerFLOW DWT™

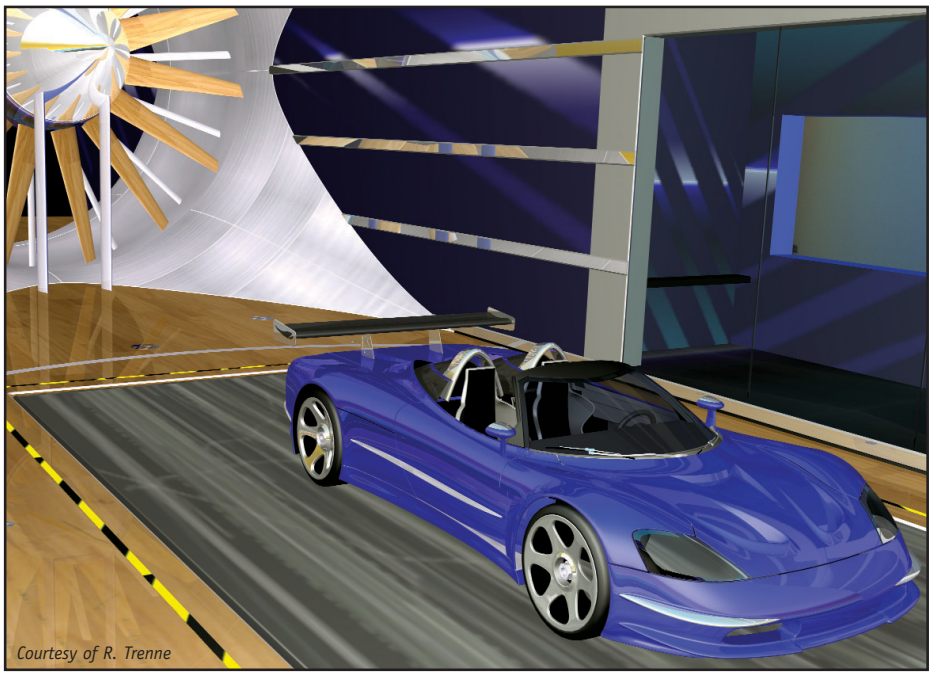
IT'S VIRTUALLY...POSSIBLE, WITH A DIGITAL WIND TUNNEL™

Over ten years of extensive development, validation, and input from experimentalists has made PowerFLOW DWT (Digital Wind Tunnel) a tried and true method for performing wind tunnel testing through computer simulation. This breakthrough technology, combined with today's commodity computer hardware, allows Exa to offer a wind tunnel simulation solution that complements and expands the capabilities of physical wind tunnels. Worldwide automotive manufacturers agree, PowerFLOW DWT is a reliable method that significantly enhances today's aerodynamic and aeroacoustic engineering design testing and analysis efforts.

With PowerFLOW DWT, aerodynamicists and engineers can take advantage of digital tools designed specifically to replicate enhanced tunnel tests such as oil flows, rolling roads, surface pressures, detailed flow visualizations and more. In addition, a PowerFLOW DWT test simultaneously collects data for each and every point within the tunnel – allowing engineers and stylists to gain critical insight into the aerodynamic flow interactions. Thanks to Exa, engineers can truly view, communicate, analyze and understand tunnel test results with their design teams as never before.

BENEFITS

- > Perform tests earlier in the design cycle and bring products to market faster
- > Gain understanding and insight not possible in physical testing – allowing more efficient optimization
- > Enhance communication among team members by utilizing state-of-the-art, visualization and collaboration tools
- > Save on model builds, travel time, expensive delays and testing documentation
- > Compete as never before by performing complex tests not possible in a physical tunnel



Courtesy of R. Trenne

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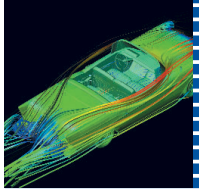
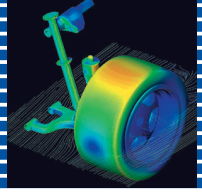




THE POWERFLOW DWT™ (Digital Wind Tunnel)

PROVEN ACCURACY

Over the past ten years, Exa Corporation has earned an excellent reputation for achieving consistent, accurate fluid flow results – fully validated and used in production at top manufacturers worldwide. In addition, Exa's patented DIGITAL PHYSICS® technology, a robust and proven approach for digitally simulating fluid flow, has made handling even the most complex wind tunnel tests (even those with time-varying conditions) easy to perform. PowerFLOW DWT combines state-of-the-art physics modeling and software development, resulting in the most accurate, scalable, and feature-driven digital wind tunnel technology available.

DIGITAL SIMULATIONS OPEN UP A NEW REALM OF POSSIBILITIES

A PowerFLOW wind tunnel simulation offers a series of benefits simply not achievable with a physical wind tunnel today, including:

- Identify drag and lift contribution by component or feature
- Digitally document all test setups and run time data for future reference
- Perform Rolling road/rotating tire simulations with yawed flow
- Obtain detailed test data simultaneously with every run such as surface pressures, oil flows, complete flow field data and acoustics
- Run underhood flows and identify underbody pressure losses early in the design cycle
- Easily upgrade and expand capacity for faster turnaround

COST EFFECTIVE PERFORMANCE

PowerFLOW offers significant added value to companies with and without existing wind tunnel capabilities:

- Physical wind tunnel users can identify optimal designs using PowerFLOW as their digital tunnel prior to physical testing, insuring more cost effective use of tunnel time.
- Tunnel capacity limitations are no longer a problem. At competitive prices, employees can be up and running digital tunnel simulations within days – quickly expanding throughput, resulting in higher quality designs and shorter time to market.
- Proven, virtual aerodynamic analysis is now possible for companies that previously had no access to physical wind tunnels, allowing them to cost effectively compete with the world's top engineering firms.

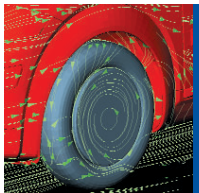
WIND TUNNEL SPECIFICATION COM

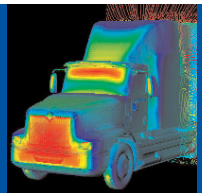
Wind Tunnel Feature/Capability
Tunnel Type
Nozzle Area
Blockage
Test Section Length
Maximum Speed
Turntable
Inlet Turbulent Intensity
Boundary Layer Control

WIND TUNNEL FEATURE COMPARISO

Force Balance
Flow Field Visualization (smoke)
Flow Measurement (vel., temp., press.)
Oil FLows
Surface Pressure Taps
Surface Measurement (vel., temp., press.)
Water Management/Soiling
Time-dependent Data
Surface Loads (Nastran I/F)
Body Forces by Component or Feature
Underhood Flow Measurements
Acoustics Noise Sources
Rotating Wheels/Rolling Road
Multi-Vehicle Studies
Brake Cooling
Underhood/Underbody Thermal Tests
Sunroof/Open Window Tests
Heat Transfer Coefficients

LEGEND KEY





MPARISON

PowerFLOW Digital Wind Tunnel	Aerodynamic Tunnel Full-Size Vehicles	Aerodynamic Tunnel Full-Size Vehicles	Aerodynamic Tunnel Model-Size Vehicles	Climatic Tunnel
Closed Test Section	Closed Test Section	Open Jet	Open Jet	Open Jet
2000m²	20 - 50m²	10 - 30m²	5 - 8m²	1 - 4m²
0.1%	10 - 15%	N/A	N/A	50%
User Selectable	10 - 20m	10 - 20m	2 - 6m	8-12m
130 m/s	30 - 70 m/s	30 - 70 m/s	30 - 50 m/s	30 - 50 m/s
+/- 180°	+/- 30°	+/- 30°	+/- 30°	+/- 30°
User Selectable (0.1-20%)	Fixed	Fixed	Fixed	Fixed
User Selectable	Fixed	Fixed	Fixed	Fixed

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● Always Available ❍ Availability Varies – Not Typically Available

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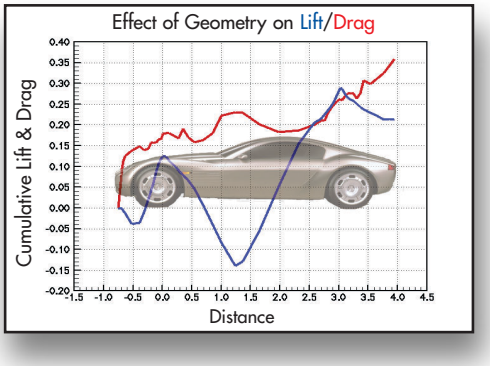
MONEY SAVING BENEFITS

- ✔ Reduce physical prototypes
- ✔ Decrease the number of required experimental tests
- ✔ Engineers time spent on results analysis instead of set up and data collection
- ✔ Gain confidence early in the design cycle that prototypes meet criteria
- ✔ Bring highly competitive, superior quality products to market
- ✔ Shorten time to market
- ✔ Avoid costs of building or upgrading a physical wind tunnel
- ✔ Gain unprecedented new insight into flow behavior
- ✔ Run simulations around the clock - not just when your engineers are working

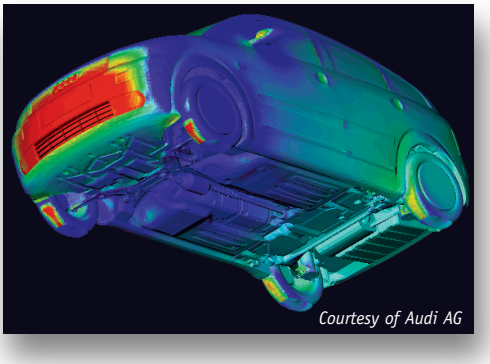


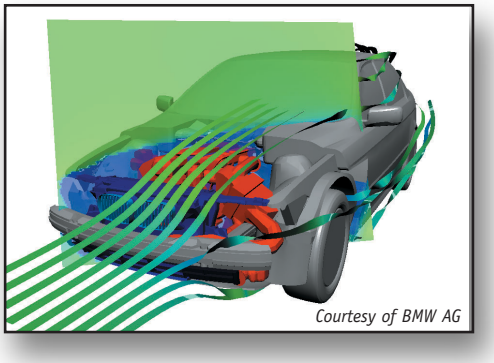
<< GRAPH DATA

Analyze multiple models at the same time. View and compare data results with visualization images to identify components or problem areas effecting optimal aerodynamic performance.

COMPLEX GEOMETRY >>

Perform simulations of even the most complex situations including rolling road/rotating tires and drafting effects. Even detailed underhood and underbody structures are simple with PowerFLOW.


Courtesy of Audi AG


Courtesy of BMW AG

<< VISUALIZE STRUCTURES

Visualize data in thousands of different ways from streamribbons and oil lines to planar trislices colored to represent anything from pressure to velocity. Watch flow structures develop and change right before your eyes...over and over again.

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To contact a regional office worldwide or distributor near you, please call our corporate headquarters.

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PowerFLOW DWT runs may be performed online via the Internet using Exa's AccessCAE ASP service. Call or email for more information.

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