



CFD RACE TO MARKET

HPC USER FORUM

September 13-15, 2010

THE GREEN FLAG WON'T WAIT...



- Swift Engineering: Winning the Race of Market Innovation...
 - *Established in 1983 specifically for motorsport design*
 - *Expanded company's culture and approach into other markets in the 1990s*
- 60,000 Sq Ft purpose built, state-of-the-art facility in Southern CA, providing:
 - *Vertically integrated in-house design to manufacturing capabilities*
 - *Product development assistance (products first-to-market)*

SWIFT'S CULTURE

- 27 years of continuous motorsports design: 10 series, 500+ cars, 40+ championships
- Motorsports = INNOVATION/PERFORMANCE/RACE-TO-MARKET
- Leverage Swift's culture, approach, in-house talent and capabilities into different markets



SWIFT INDUSTRY EXPERTISE

AUTOMOTIVE



AEROSPACE



AVIATION



- Collaborative projects with global client/partners, including:



- Collaborative projects in **OTHER** market sectors include:



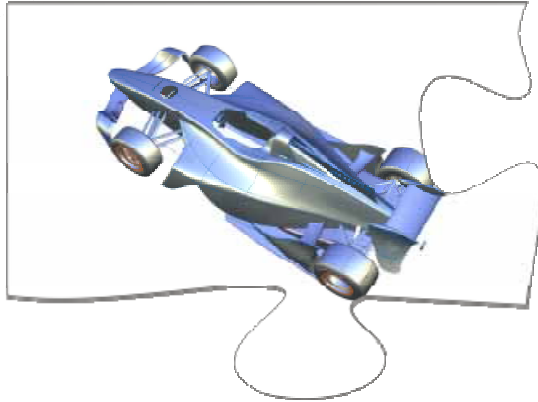
THE RACE OF MARKET INNOVATION



SWIFT: SPEED-TO-MARKET



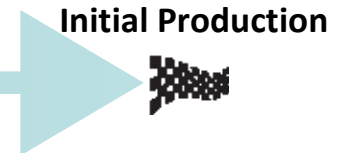
PRODUCT DEVELOPMENT CAPABILITIES



Conceptual Design

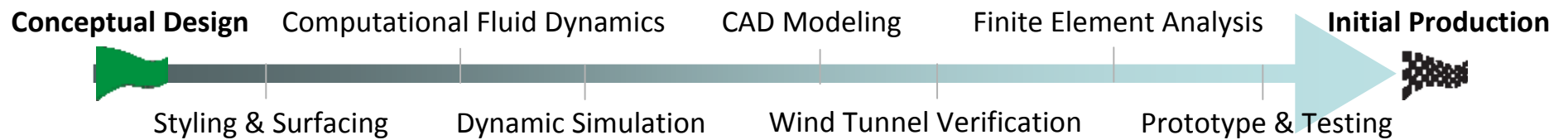
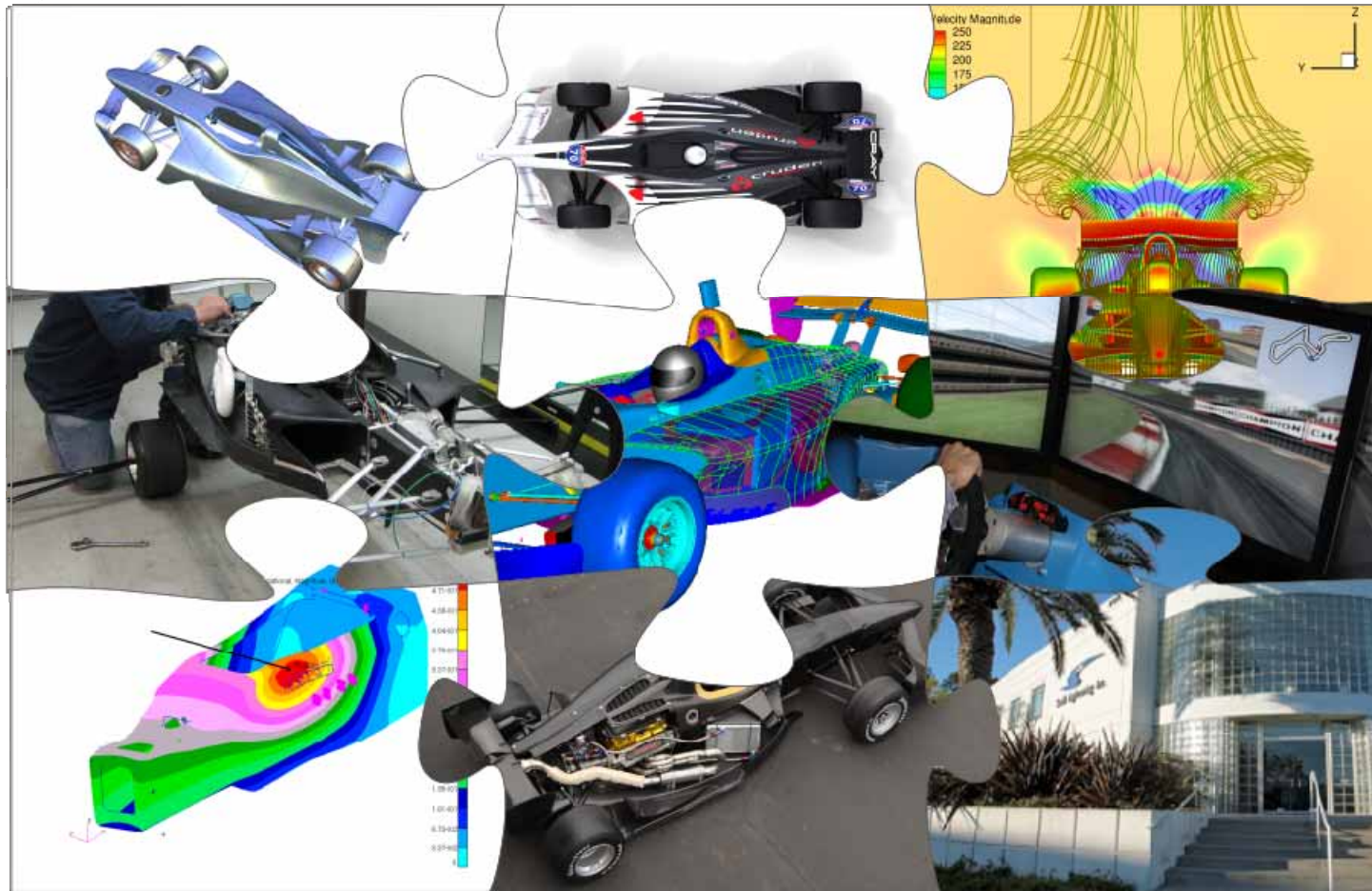


PRODUCT DEVELOPMENT PROCESS

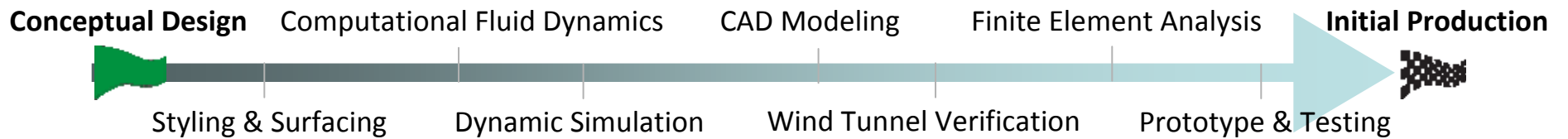


Initial Production

PRODUCT DEVELOPMENT CAPABILITIES

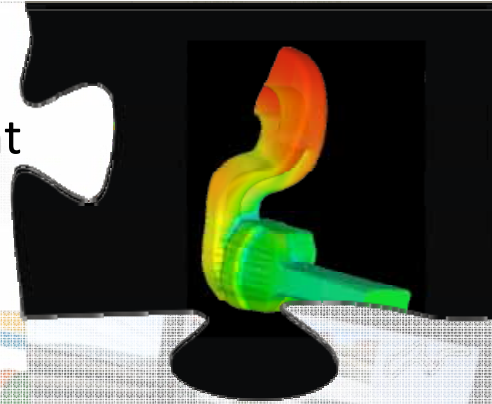


PRODUCT DEVELOPMENT CAPABILITIES



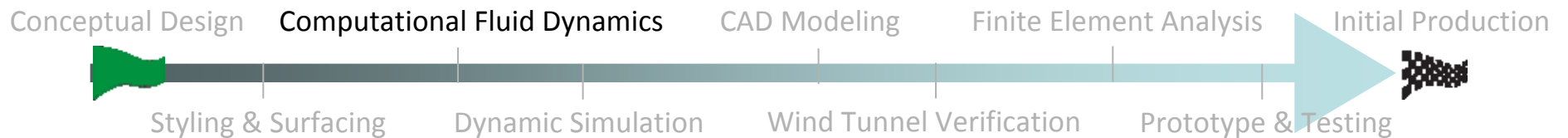
CFD CORNERSTONE CAPABILITY

Aero performance is the critical key component to Swift's product development from racecars to airplanes to hairdryers!



Swift's increased CFD capabilities improve speed-to-market:

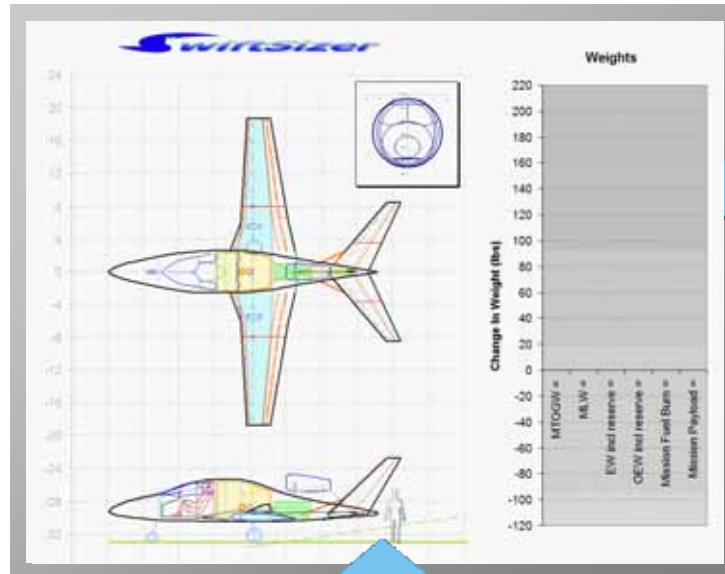
- *Model generation and modification faster in virtual environment*
- *Ability to run multiple complex models in same environment*
- *Increased data points and analysis capabilities*



PRODUCT DEVELOPMENT CYCLE

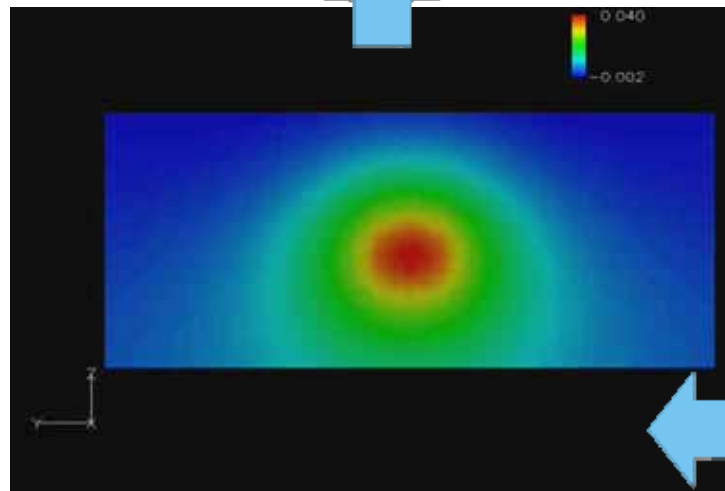
SwiftSizer MDO

- Layout
- Performance
- Stability & Control
- Weight & Balance
- Sizing
- Optimization



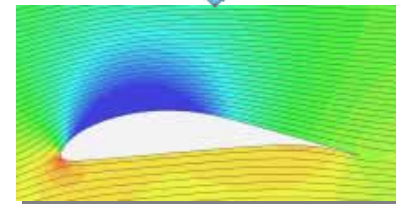
CFD++ Cray^{CX1000}

- 3D Aero
- Loiter Drag
- Dash Drag
- Stability
- 3D C_{Lmax}



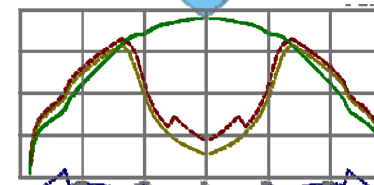
CATIA v5

- Packaging
- Big-Bones
- FEA



Xfoil CFD++

- Airfoil Design
- Cruise Bucket
- Section C_{Lmax}



Vortex Lattice

- Loiter Span-load
- Trimmed C_{Lmax}
- Trimmed Dash



ALIAS

- Class-A Surface
- Definitive OML

HPC for Better Entertainment



Closer Racing = More Entertainment
Less Wake Upset = Closer Racing

With CFD Swift can
“Design the Wake”

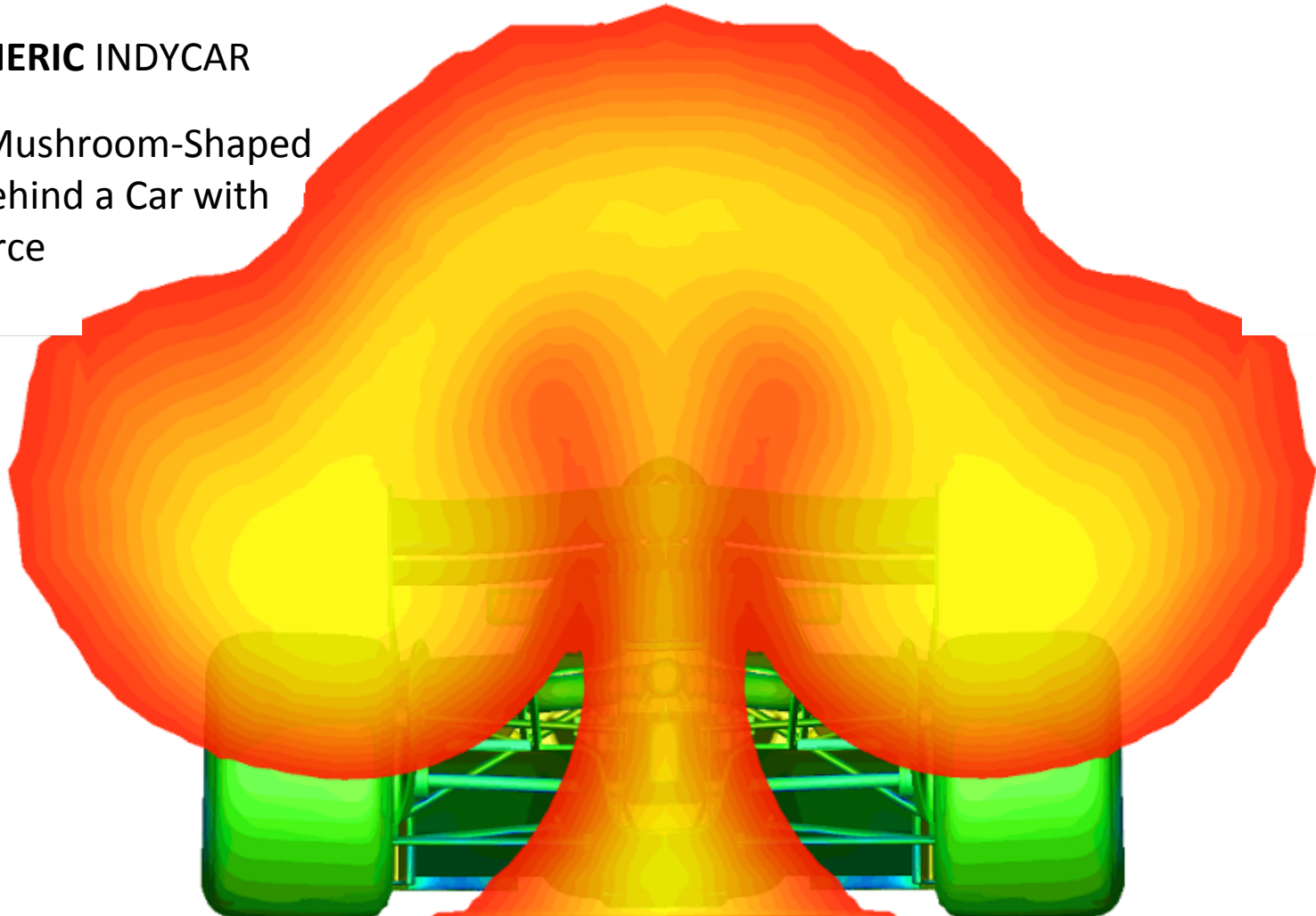
SWIFT INDYCAR DESIGNED FOR ENTERTAINMENT

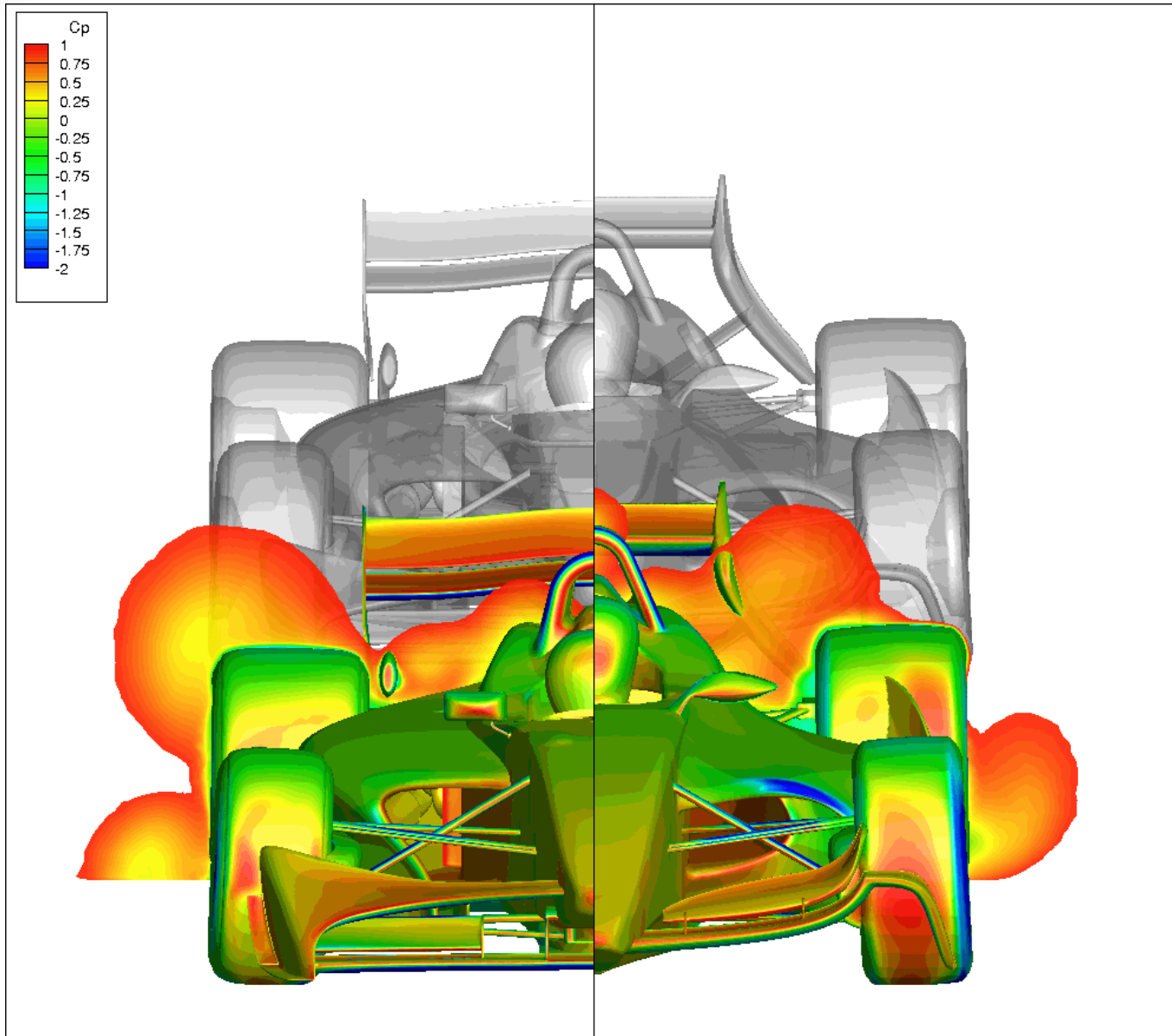


SWIFT INDYCAR DESIGNED FOR ENTERTAINMENT

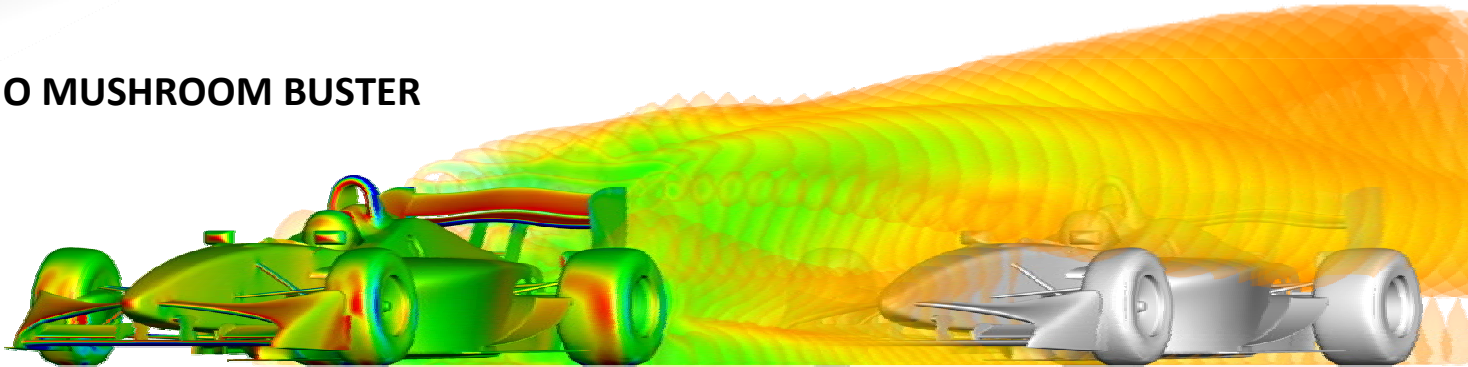
GENERIC INDYCAR

Classic Mushroom-Shaped Wake Behind a Car with Downforce

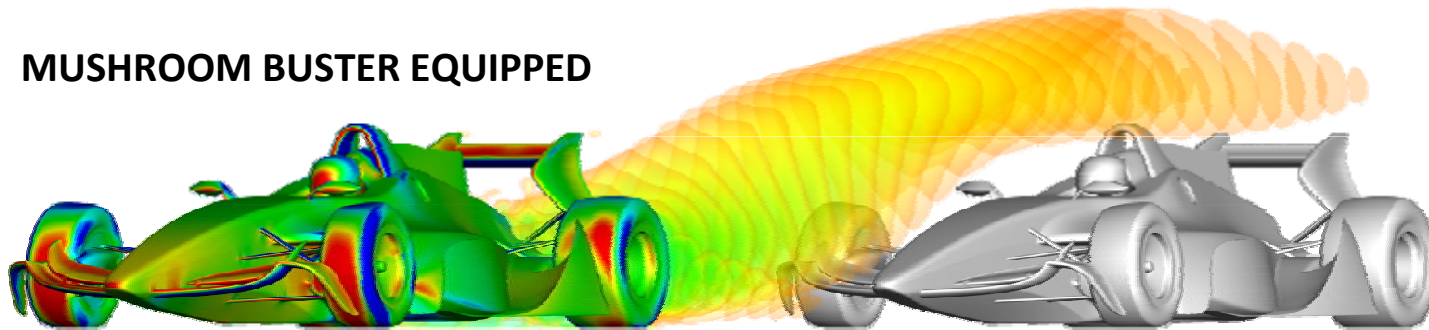




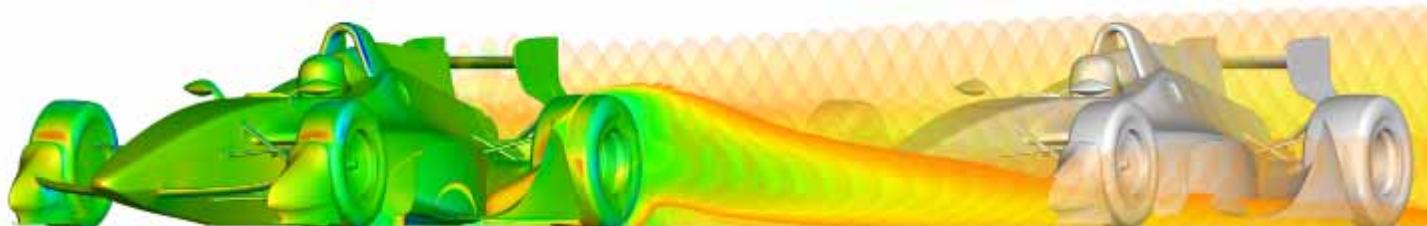
NO MUSHROOM BUSTER



MUSHROOM BUSTER EQUIPPED



MUSHROOM DISABLED (SPEEDWAY CONFIGURATION)



SWIFT HPC SYSTEM

- Cray CX1 for Pre and Post Processing
- Mesh Tools;
 - “ANSA”, “MIME”
- Post-Processing;
 - Metacomp visualizer
 - TecPlot
 - NVidia GX4800 graphics card
- Cray CX1000
 - 18 node compute array
 - Each node is a dual-processor quad-core
 - Total of 144 compute array processors
 - 36 port Infiniband QDR switch

SWIFT HPC SYSTEM

- Each compute node has 24GB of RAM
- 18 nodes = 432GB of RAM
- Storage;
 - 12TB scratch (RAID 0 config for jobs in the queue)
 - 12TB storage (RAID 6 config to archive older data)
- Flow Solver; CFD++ written by MetaComp Technologies
 - Fully structured meshes
 - Fully unstructured meshes
 - Moving mesh module
- Biggest job to date - High lift grid - 73 Million cells
- Max capability is 200 Million cells

Wind Tunnel vs. CFD at Swift

Wind Tunnel

5 vehicles / year

30,000 configurations / year

300,000 points / year

CFD

20 Vehicles / year

200 Configurations / year

600 points / year

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

Wind Tunnel vs. CFD at Swift



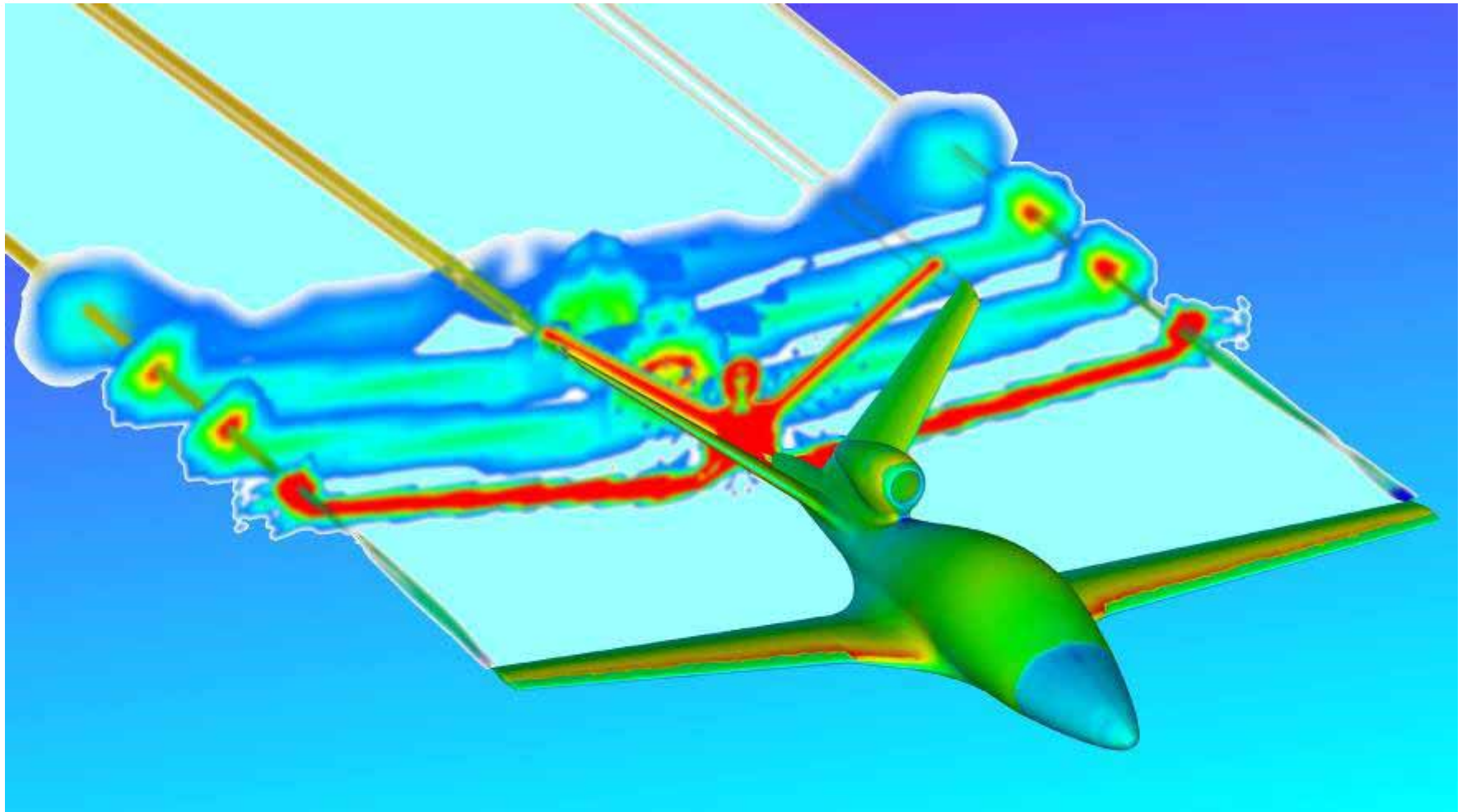
**Wind Tunnel
5 vehicles / year**



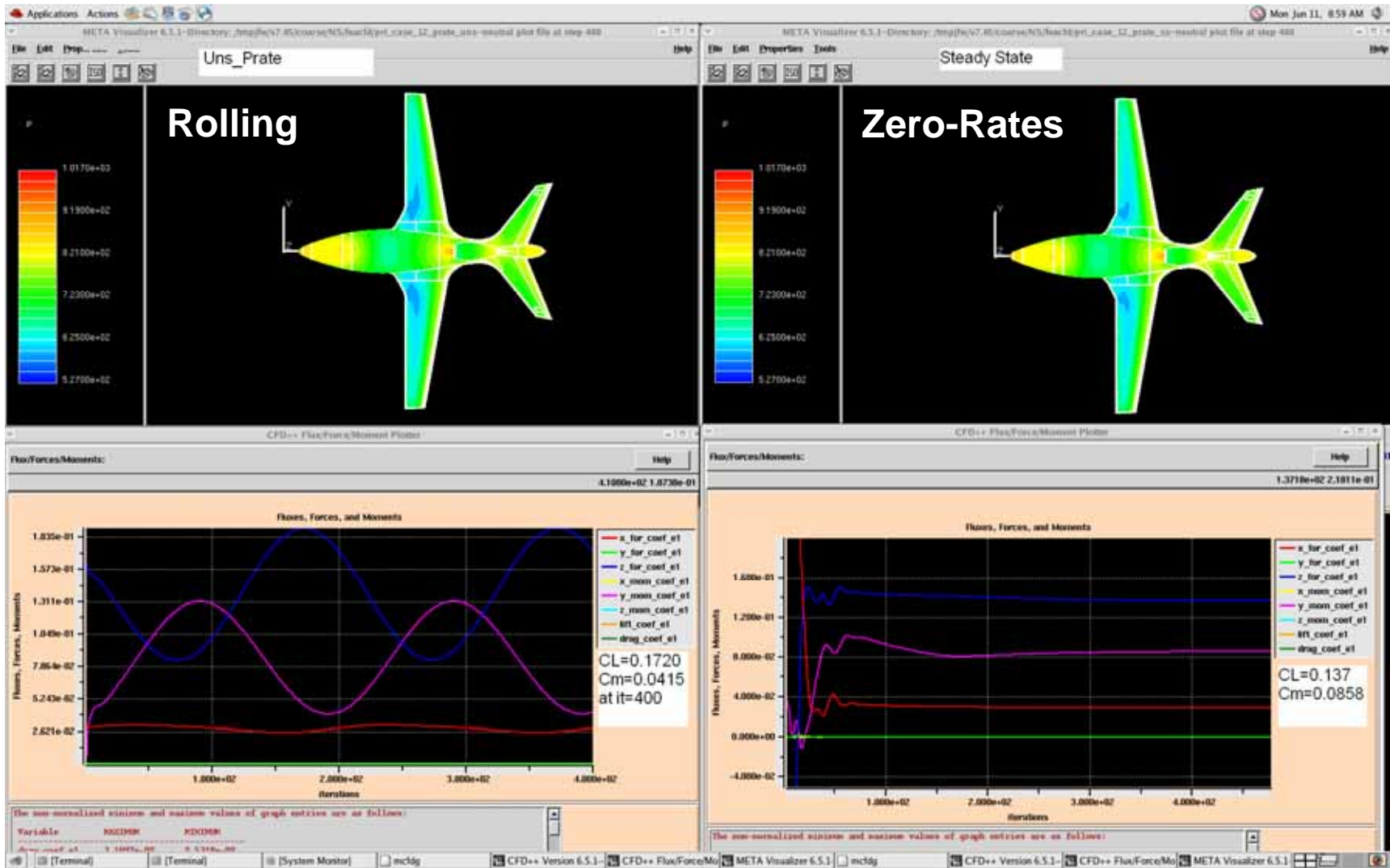
**CFD
20 Vehicles / year**

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

Eclipse Concept Jet Wake Survey - CFD++



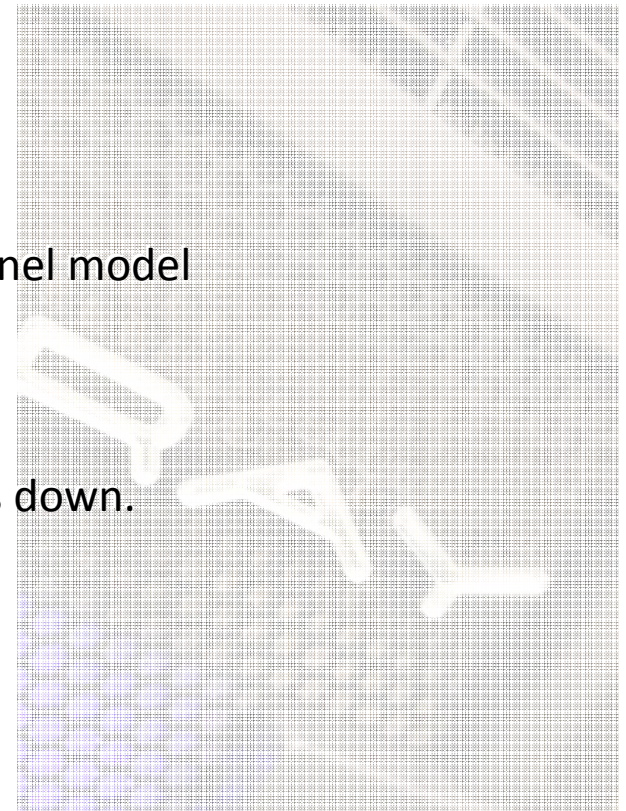
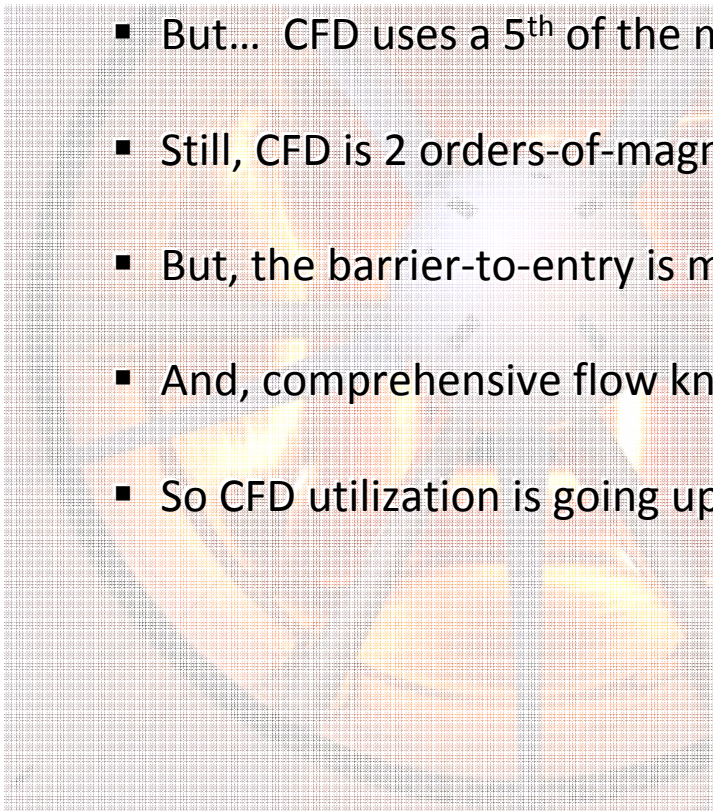
Unsteady CFD Loads for FEA Analysis



WIND TUNNEL VS. CFD AT SWIFT

Swift's added HPC resources with Cray's CX-1 and CX1000 HPC:

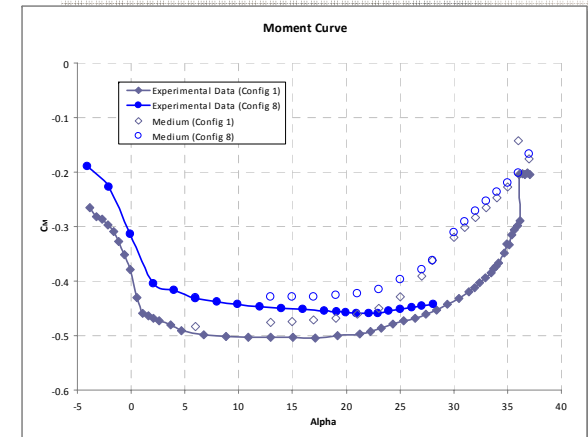
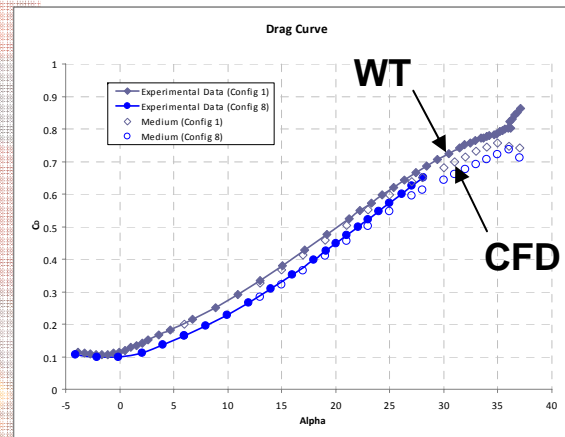
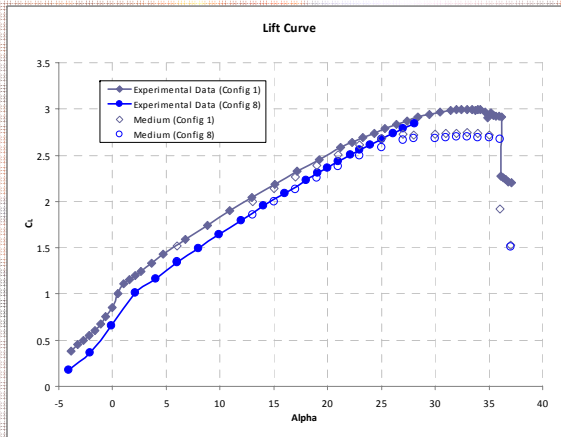
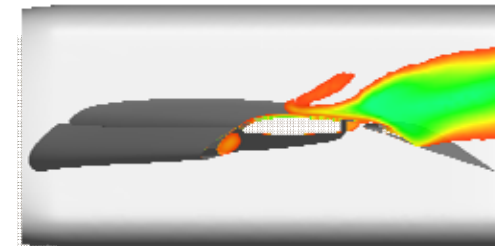
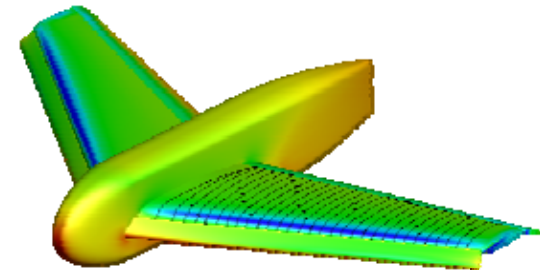
- CFD is 500 times *less* productive than our Wind Tunnel
- But... CFD uses a 5th of the manpower
- Still, CFD is 2 orders-of-magnitude less productive
- But, the barrier-to-entry is much lower without a wind tunnel model
- And, comprehensive flow knowledge is invaluable
- So CFD utilization is going up while our Tunnel utilization is down.



WIND TUNNEL-CFD CORRELATION AT SWIFT

2010 AIAA 1st High-Lift Prediction Workshop

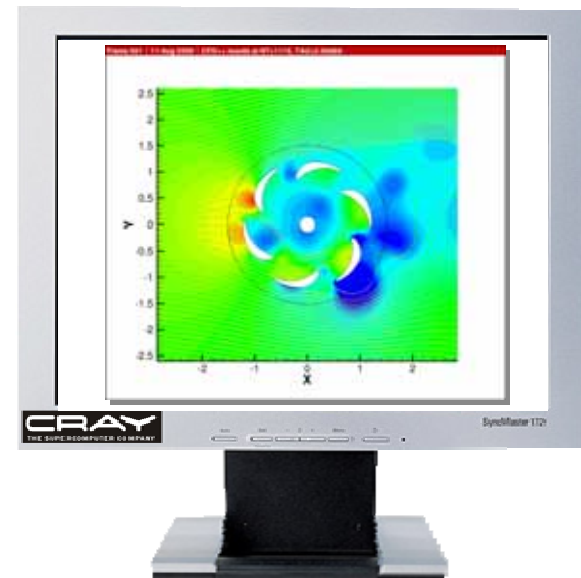
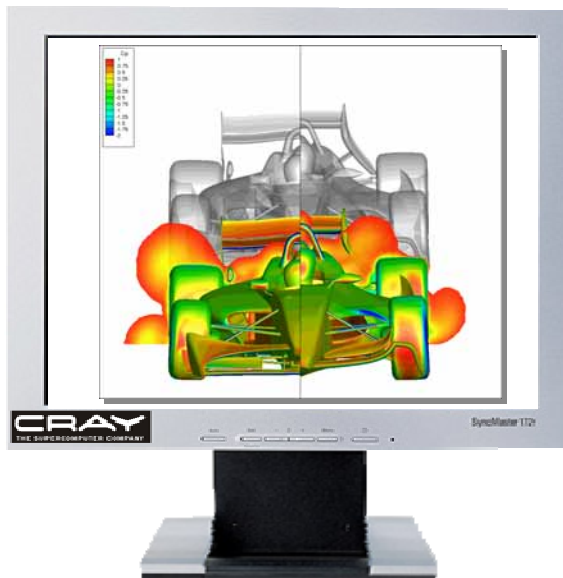
Swift is participating with major Aerospace companies to validate CFD methods at moderate R_n through stall.



Correlation is excellent up to 5 degrees before stall – work continues...

SWIFT'S HPC PLANS

- CFD-based Optimization with Sculptor™ (underway)
- Continued participation in High-Lift Prediction Workshop
- Participation in Drag Prediction Workshop
- Correlation studies with FN09 WT data (underway)
- 3D time accurate windmill solutions (2D underway)
- CFD-coupled MDO with SwiftSizer





Address: 1141-A Via Callejon, San Clemente, CA 92673

Phone: 949-492-6608



Internet Home Page: www.swiftengineering.com



Motorsports Blog: <http://swiftengineering.blogspot.com/>



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- *ISO 9001 Certified*
- *AS 9100 Certified*
- *Nadcap Audit Nov 2010*