

*2008 ASME International Design
Engineering Technical Conferences
DAC Industry Panel Session*



Optimization Solutions in Multidisciplinary Design

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Design Integration Software: The Developer's Perspective

August 5th, 2008

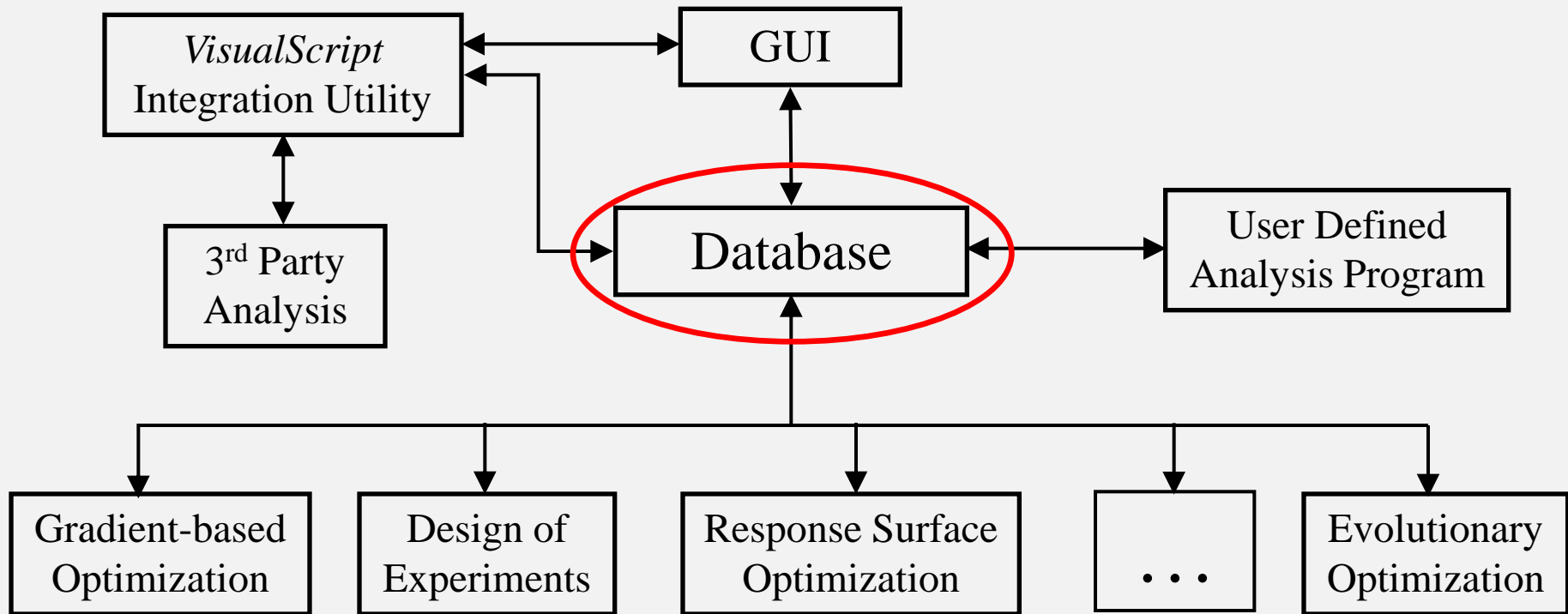
Background

- *Ph.D. from the University at Buffalo – SUNY*
- *Advisor: Kemper Lewis*
- *Research Areas: MDO, Game Theory, Rationality in Design Decisions, Uncertainty/Risk Modeling/Handling, Multi-attribute Decision Problems, Multi-objective Optimization, IT in Engineering Design*
- *Working at VR&D, Inc. for over a year*
 - *VisualDOC development, training and support.*
 - *Contributed to GENESIS Structural Optimization software development.*

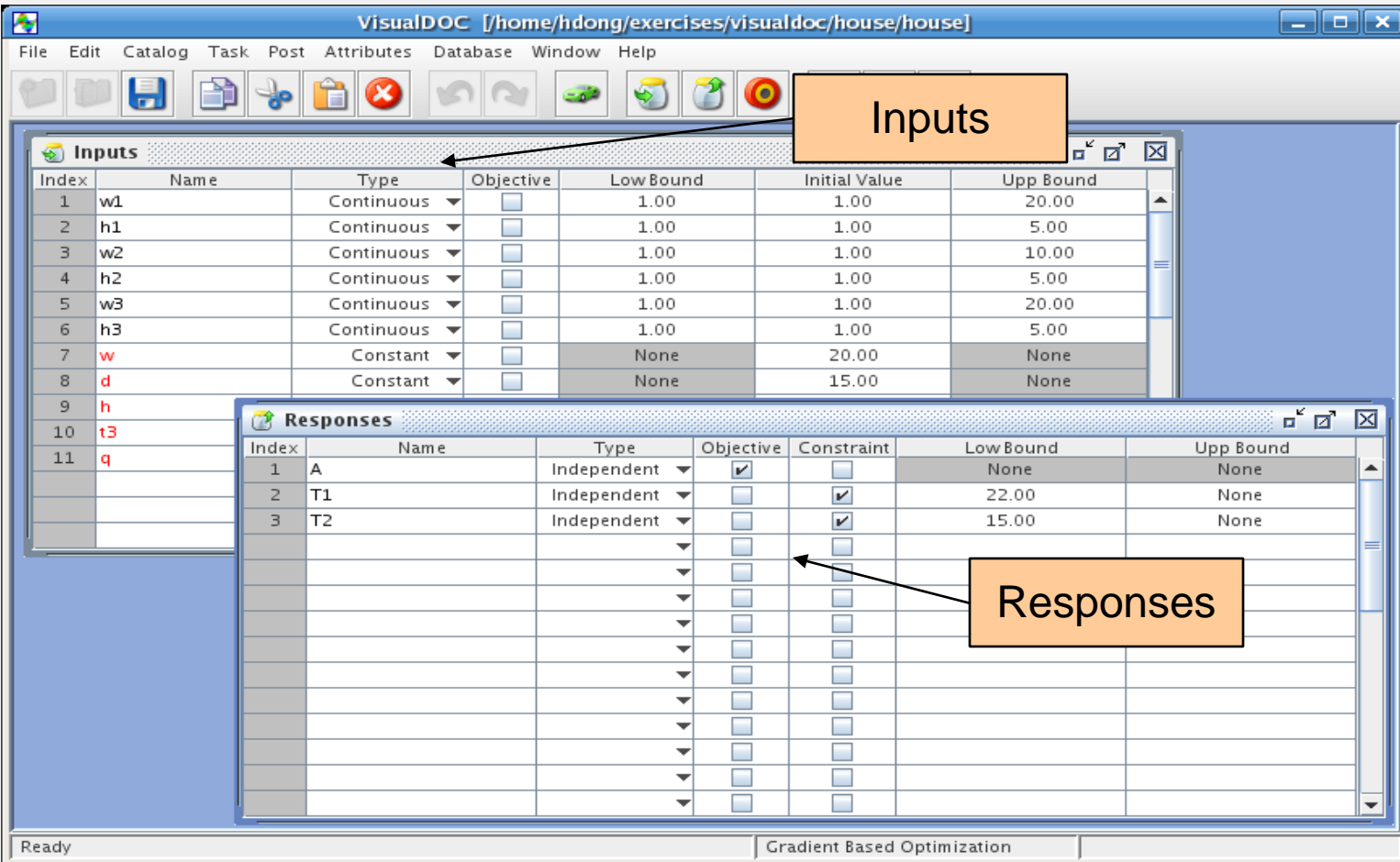


VisualDOC – Framework

- *Database is the central component of the software.*
- *Saved as platform independent .vdb file*

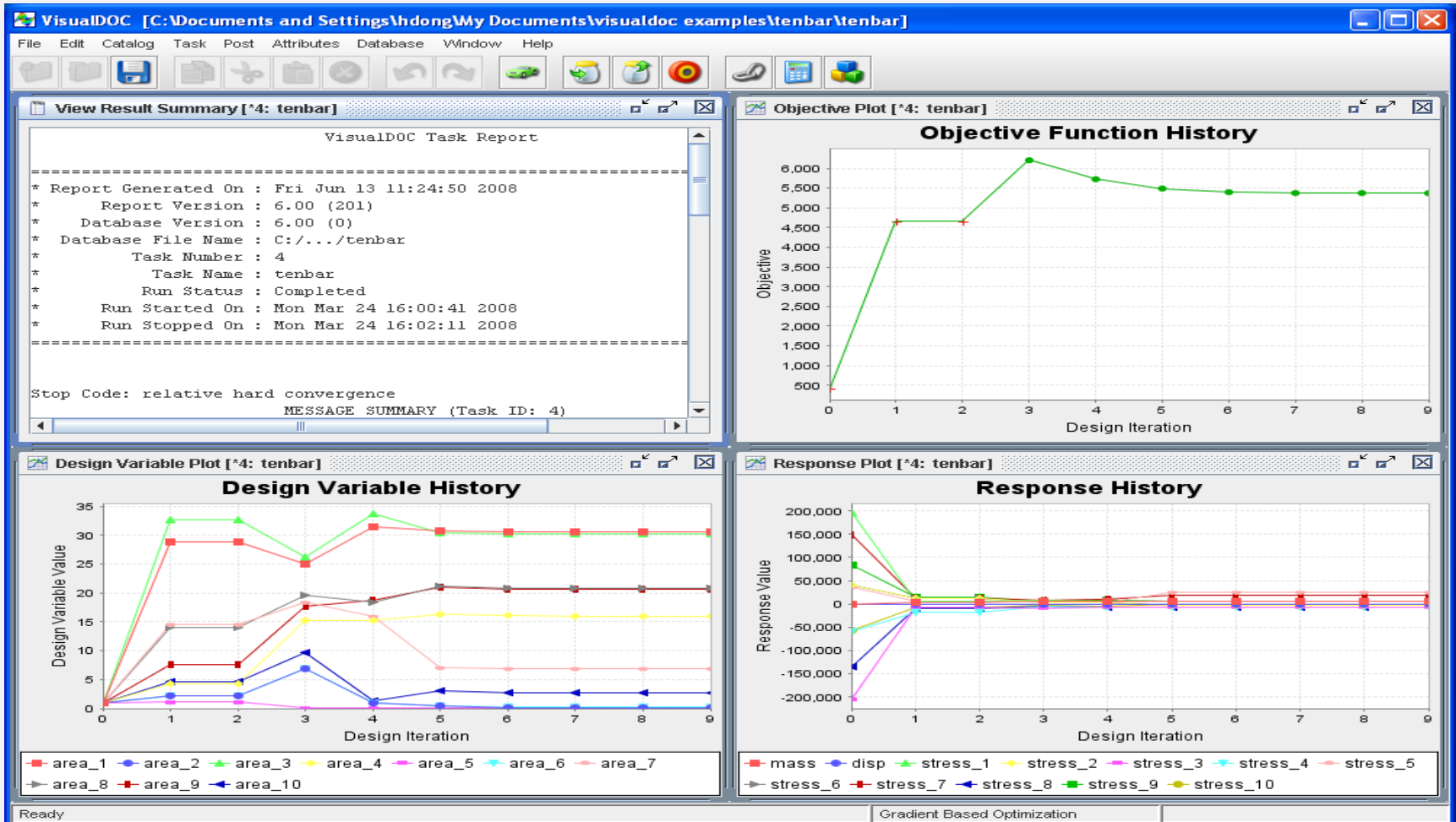


- *Excel-like spreadsheet interface to enter inputs, responses etc.*



VisualDOC – Graphical User Interface

- *Post processing options include graphs, charts and reports.*



VisualDOC – Algorithms

- *Available design and optimization algorithms:*

- *Gradient-based Optimization – DOT*

- *MMFD, SLP, SQP, FR, BFGS etc.*

- *Design of Experiments (DOE)*

- *Latin-Hypercube, Full/Fractional Factorial, Simplex, Composite etc.*

- *Response Surface Optimization*

- *Non-Gradient and Evolutionary Optimization*

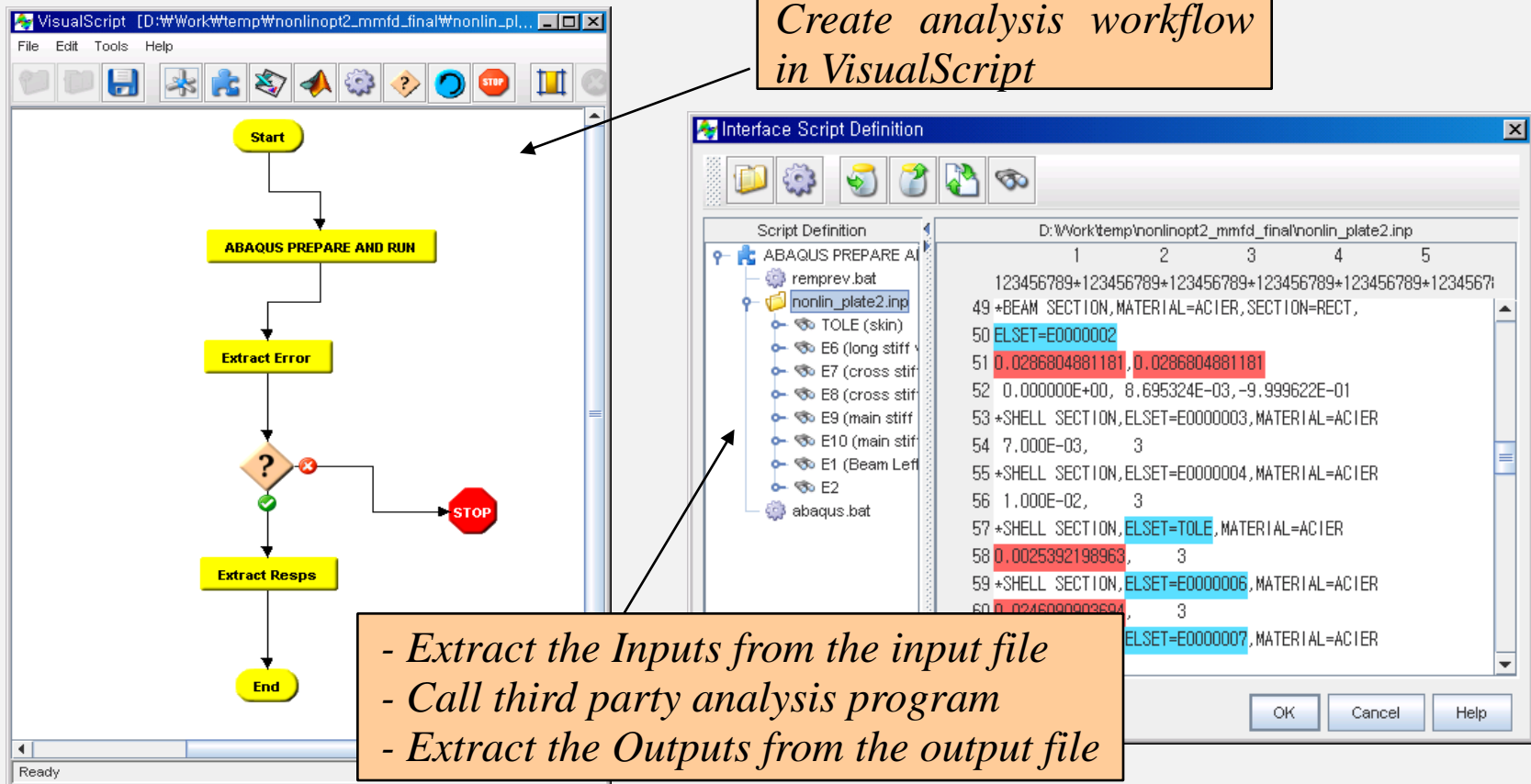
- *Genetic Algorithms, Particle Swarm Optimization*

- *Probabilistic Analysis and Optimization*

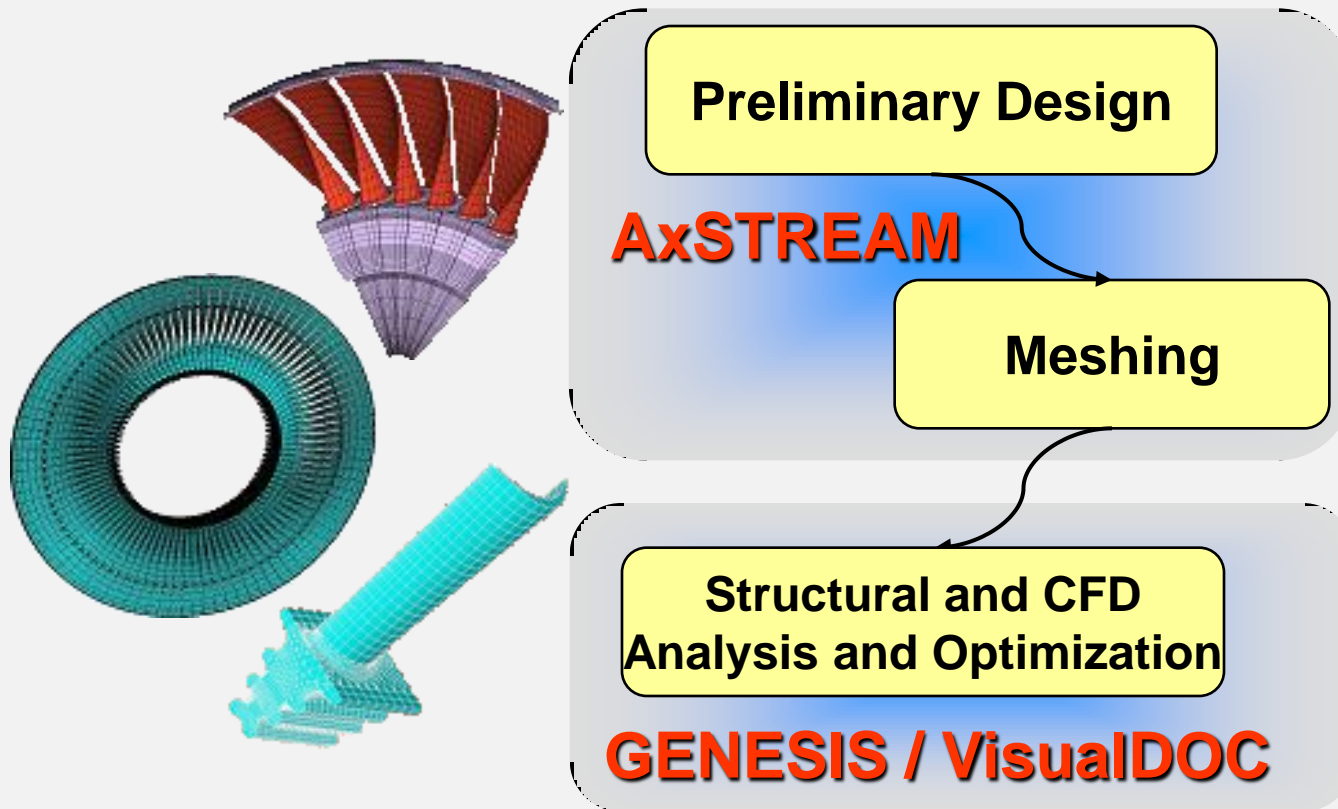
- *Design for Six-Sigma*

VisualDOC – VisualScript Integration Utility

- *VisualScript wraps optimization capability around 3rd party software.*



Case Study – Turbomachinery System Design

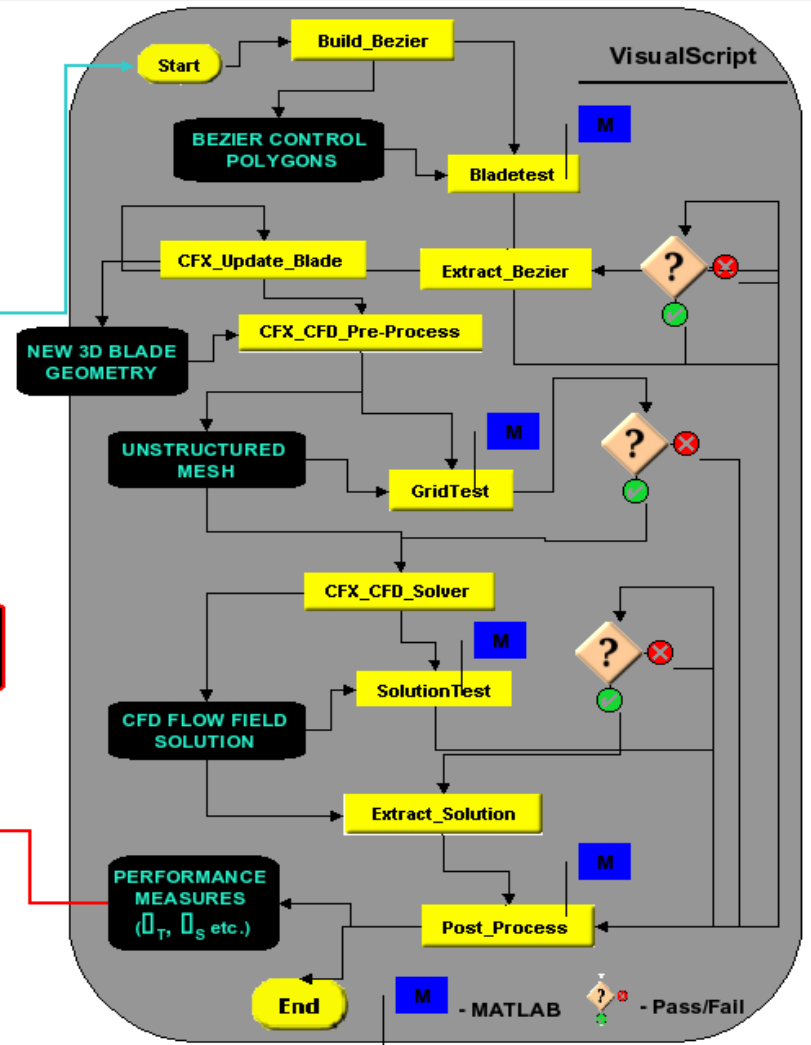
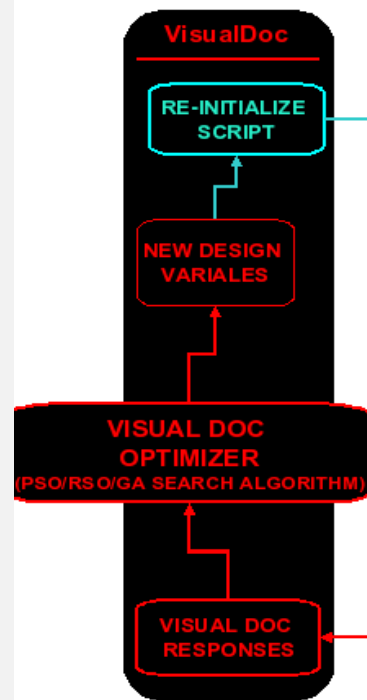
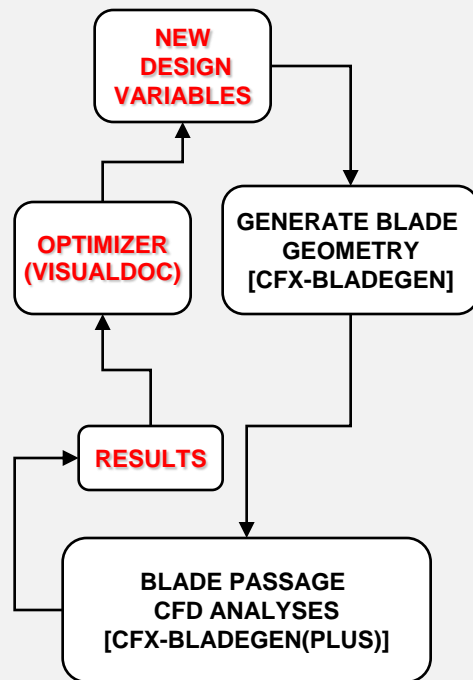


Blades, Disks, Complete Systems

Case Study – Turbomachinery System Design

Objective:

Maximize efficiency



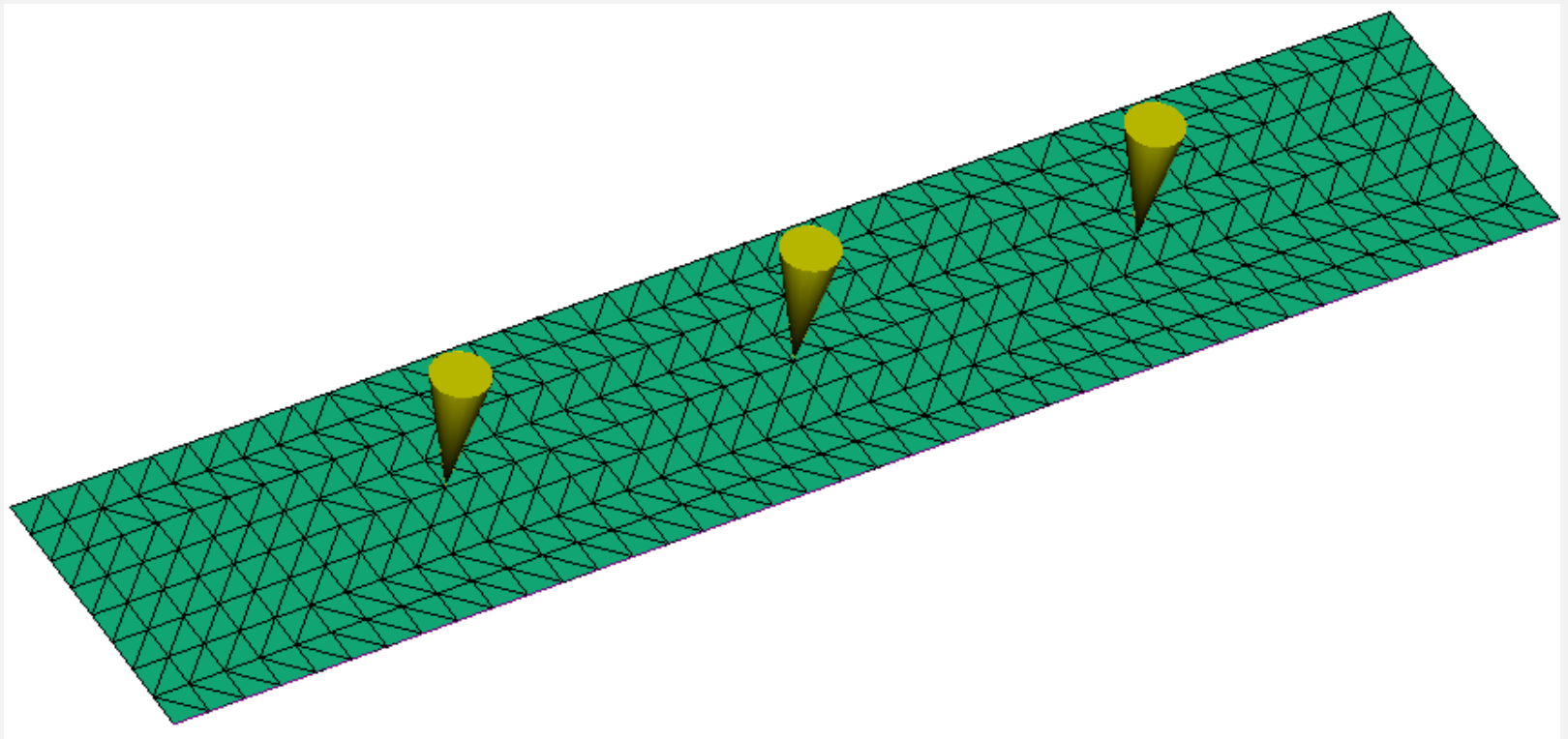
Case Study – Turbomachinery System Design

Blade Results:

- **An average of 9% increase in total efficiency was obtained**
- **Robustness of the approach evidenced in its ability to yield significant efficiency gains in spite of the noisy objective function.**

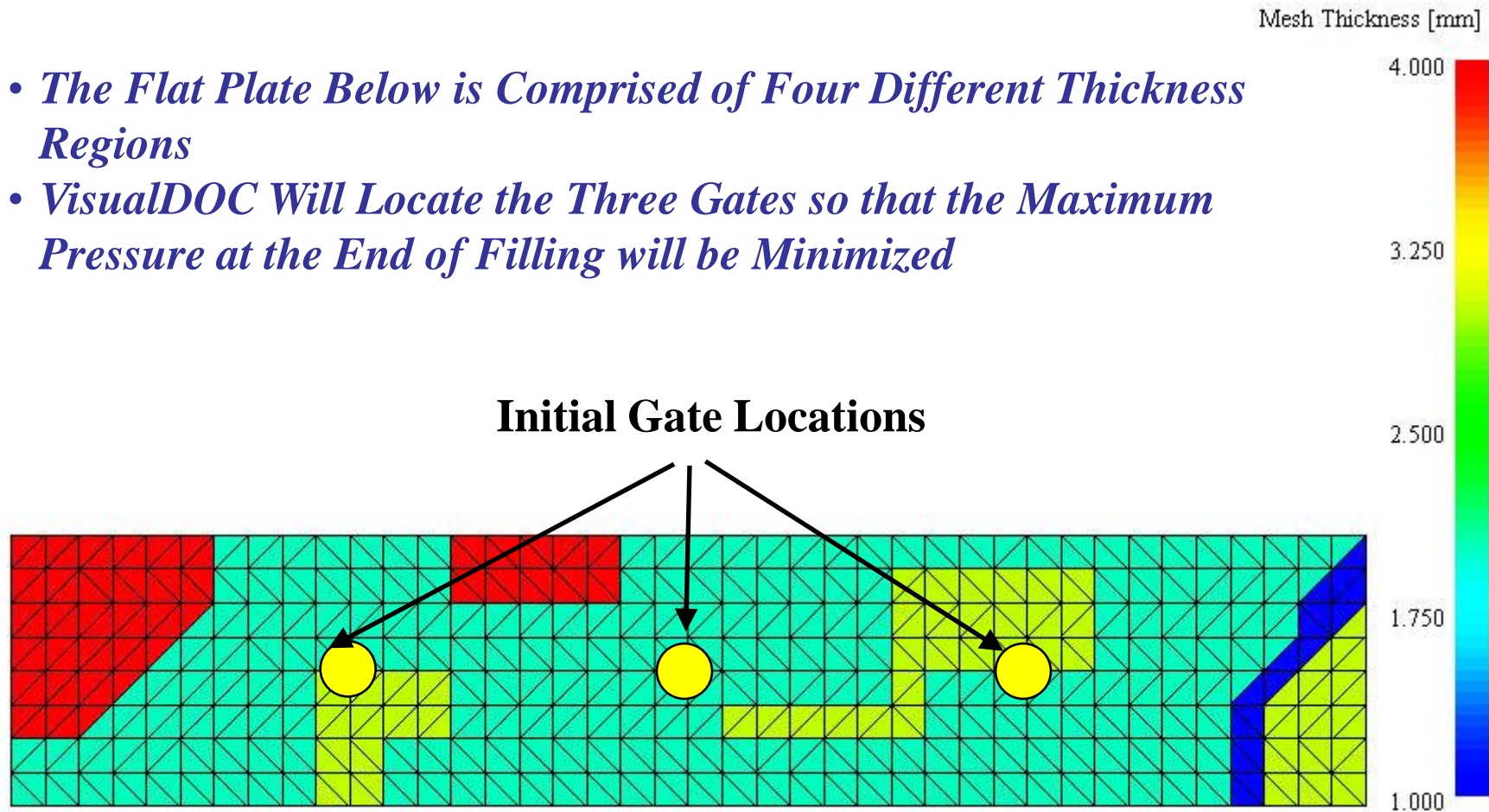
Case Study – Integration with MoldFlow

- *VisualDOC has been integrated with MoldFlow's MoldFlow Plastics Insight (MPI) software to determine Optimal gate location.*
- *Optimal gate location will be the geometry that minimizes the maximum pressure at the end of the filling.*



Case Study – Integration with MoldFlow

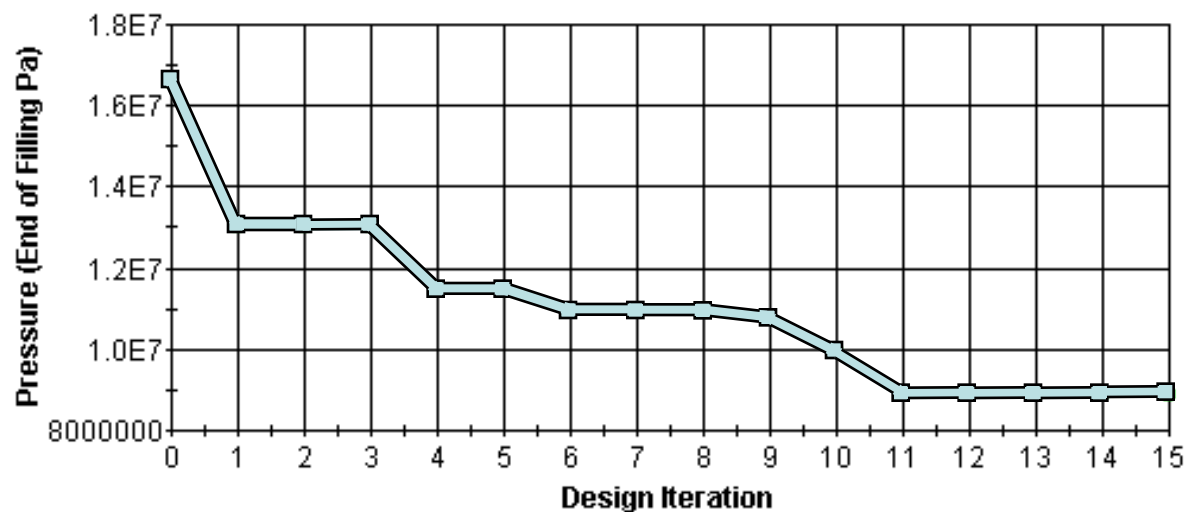
- *The Flat Plate Below is Comprised of Four Different Thickness Regions*
- *VisualDOC Will Locate the Three Gates so that the Maximum Pressure at the End of Filling will be Minimized*



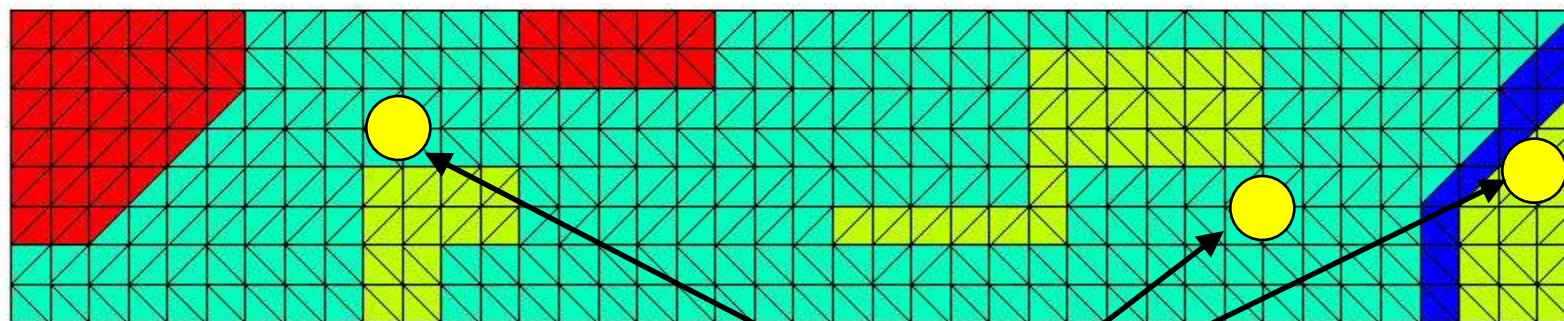
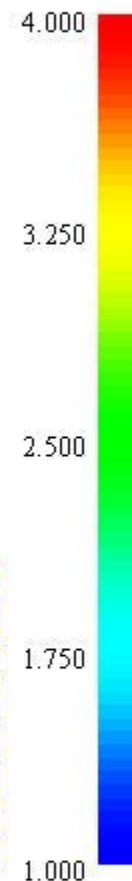
Case Study – Integration with MoldFlow

Optimization Process Sequence

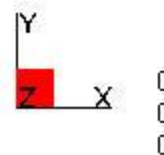
Objective Function History



Mesh Thickness [mm]



Optimal Gate Locations



Future of Design Integration Software

- *Driving force in advancement of design integration software*

Developers OR End Users?

- *Software Evolution*
 - **Increased efforts in direct software integration**
 - **Advanced algorithm development**
 - **Web-based interactivity**
 - **Immersion with Virtual Reality**

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