INTALES

A Robust Approach To Structural Analysis

A. Grassl

Natters, 2014-05-15

The Way Home

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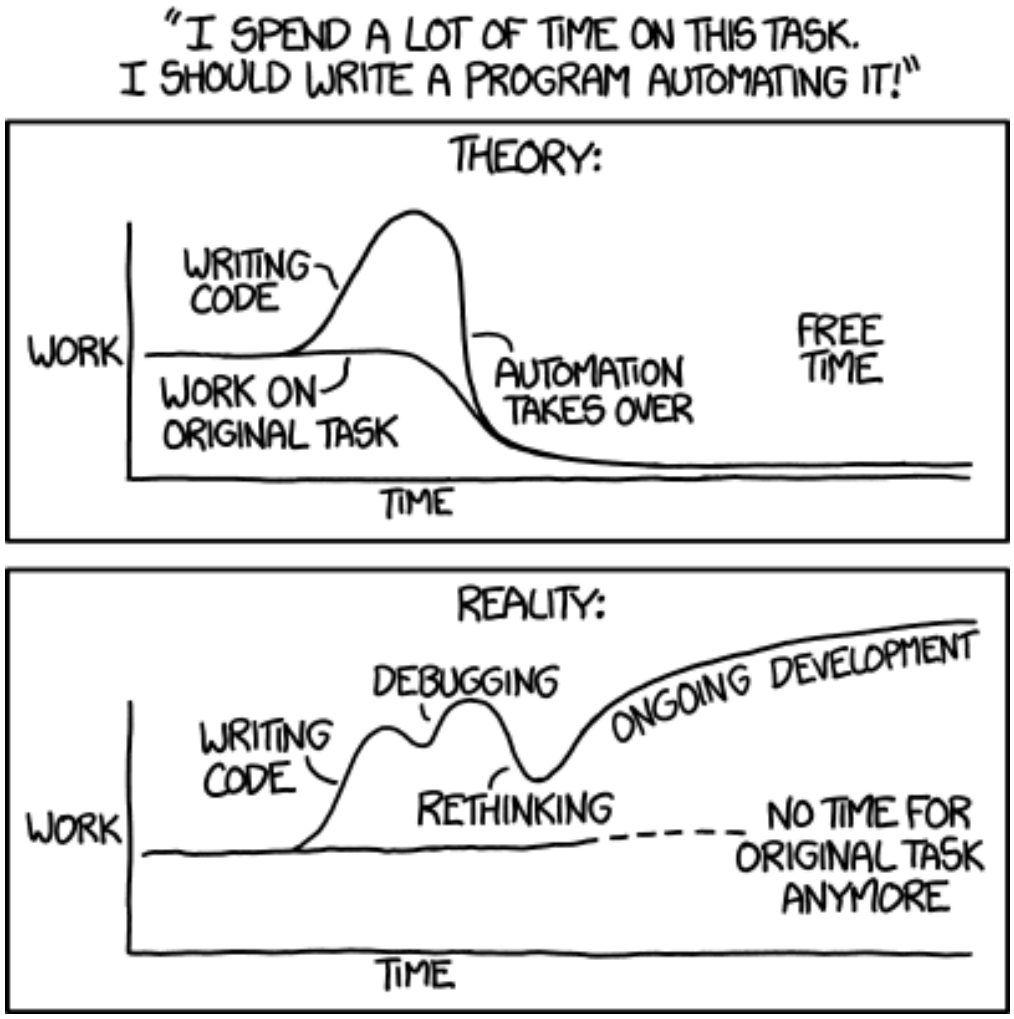

Software Development

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- Sensitivity and Reliability Analysis, Random Fields (UIBK)
- Finite Elements, ICONA-Solver (UIBK)
- Optimizer (AIRBUS Space, UIBK, CTU Prag)
- ASuperBOWL (FACC)

Structure Example

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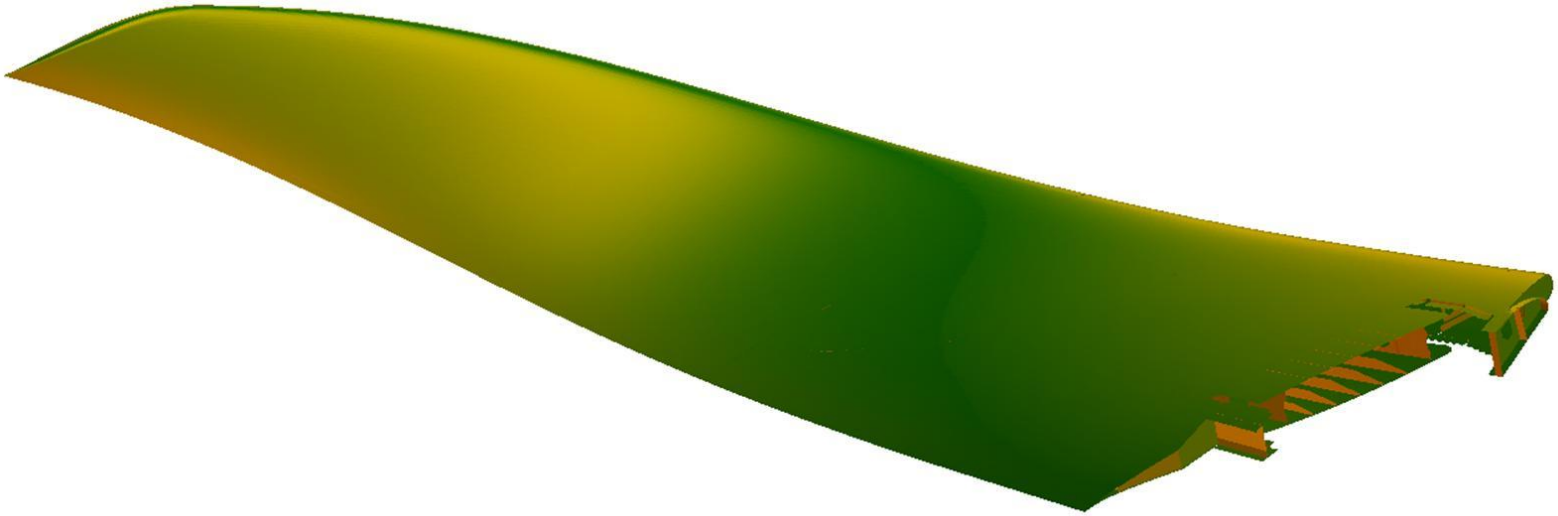
- A350XWB-900/1000 Wingtip, Winglet with
  - 460 000 Shell Elements
  - 3000 Fasteners modeled
  - 2000 PCOMPs/PSHELLs
  - Summing up to 4.1 Mio DOFs



Product Lifecycle

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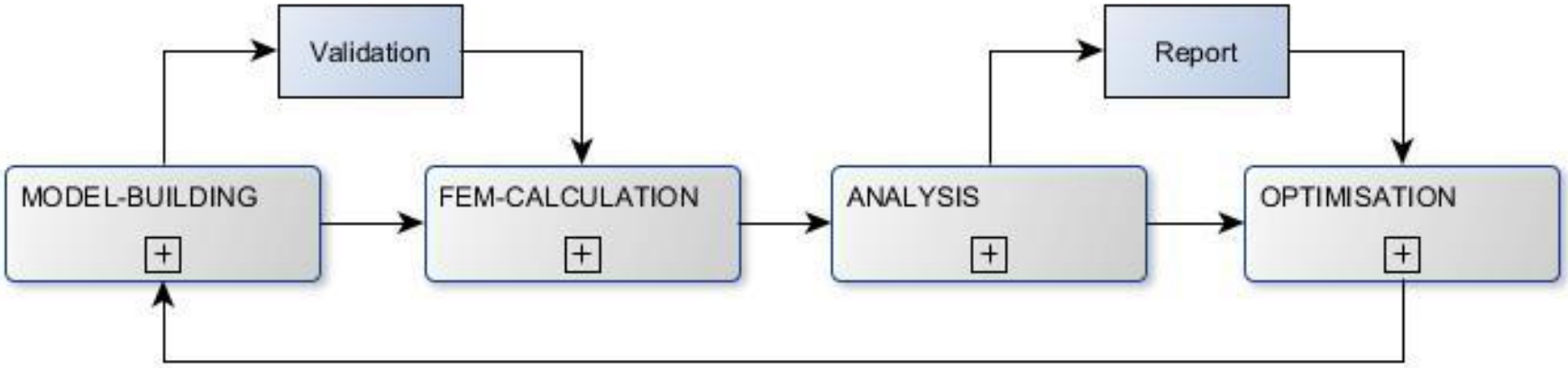

Model Build

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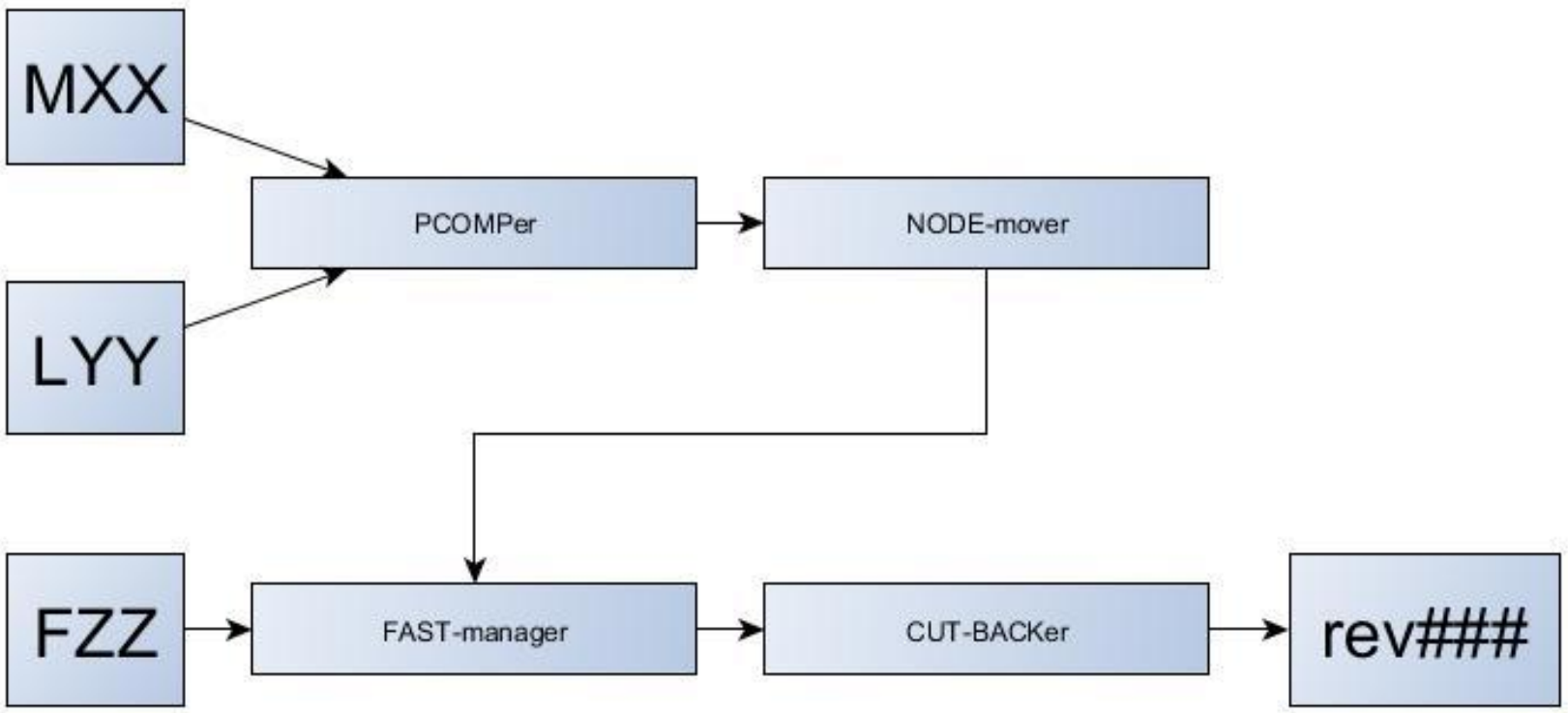

Provided Interfaces

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- Layup transfer FROM and TO Design
  - *Ply boundaries and sequence*
  - *Realistic simulation of staggering*
- Fastener transfer FROM and TO Design
  - *Fastener location, orientation and type*
- Several draping simulation methods
  - *Respect manufacturing requirements*
- Common customer approved material database

Analysis

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- Engineering judgement of raw results
  - *Fastener forces, buckling behaviour, ...*
- Failure criterions
  - *Interlaminar shear at corners, joint analysis, ...*
- Customer specific tools
  - *ISAMI, ...*
- Visualization and Reporting

Optimization

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- Allowable based
- Reserve Factor based
- In-Element

- Feedback loop
- Update at best place in workflow

Software list

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ShortCut	Module-name	development phase				Package-name
		A-MAT	B-MAT	C-MAT	MRB	
	stpParser	X	X	X		ModelBuild
	initializeDB	X	X	X		
geom	geom with OCC	X	X	X		
	meshMapper	X	X	X		
	loadMapper	X	X	X		
lyOptim	layupOptimizer	X	X	X		
PCOMPer	pcompWriter	X	X	X	X	
move	nodeMover	X	X	X	X	
fast	fastenerTool	X	X	X	X	
CB	cutBacker	X	X	X	X	
	analysisManager	X	X	X	X	
	lcPreselection	X	X	X		
	abaOptimizer	X	X	X		
	sensitivityAnalysis	X	X	X	X	
	reliabilityAnalysis		X	X	X	
MSA	INT-curvedLaminate 2D/3D (through thickness stresses)	X	X	X	X	InHouseAnalysis
MSA	INT-metallicFailure 2D	X	X	X	X	
~~IFH~~	~~INT-boltAnalysis~~	~~X~~	~~X~~	~~X~~	~~X~~	
IRB	INT-radiusBending	X	X	X	X	
FLP	INT-fastenerLoadPath	X	X	X	X	
ISW	INT-sandwichStability 2D/3D	X	X	X	X	
IPS	INT-inPlaneStrength 2D	X	X	X	X	
oOPS	INT-outOfPlaneStrength 2D	X	X	X	X	
AERO_TDD	INT-contourChecker	X	X	X		
	INT-coreRamp 3D	X	X	X	X	
	INT-fastenerFatigue	X	X	X	X	
IFB	INT-interRivetBuckling	X	X	X	X	
	INT-metallicFatigue	X	X	X	X	
CORIN	**ISAMI-Corin**	X	X	X	X	ISAMI-Accelerator
FH	**ISAMI-Filled Hole**	X	X	X	X	
~~BJ~~	~~**ISAMI-Bolted Joint**~~	X	X	X	X	
FHM	**ISAMI-Static (Metallic) Filled Hole**	X	X	X	X	
PS	**ISAMI-Plain Strength**	X	X	X	X	
BOC	**ISAMI-Bocatas**	X	X	X	X	
DT	**ISAMI-Damage Tolerance**	X	X	X	X	
OH	**ISAMI-Open Hole**	X	X	X	X	
elsPP	elsPostProcess	X	X	X	X	PostProcessing
picsPP	picsPostProcess	X	X	X	X	
splitPCH	splitPunchFile	X	X	X	X	

Database Storage

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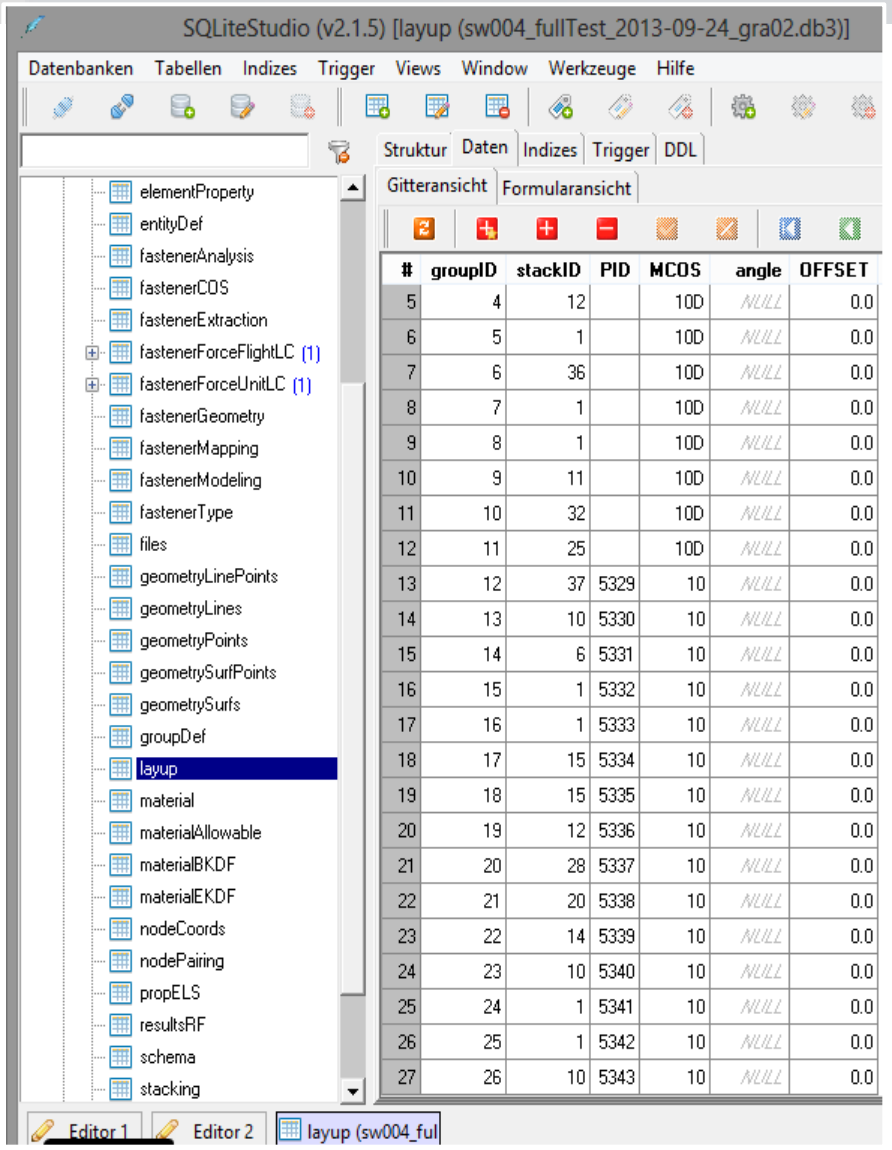
- SQLite
- Model & Results
- Workflow-supporting
- Transparent interaction
- Full traceability in ONE file
  - *Model Data*
  - *Critical RFs and Loads*
  - *Data Manipulation Support*
  - *Methods/Tools Traceability*
  - *...*



Advantages

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- Modular model build
- Working in parallel
- Automated build-up and analysis
- Integrated checking procedures
- Fast optimization loops
- Robust data exchange
- Robust data handling

Data Handling

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- Nastran model: ~0.2 GB
- Loads: ~8 GB
- Nastran output: ~50 GB
- ISAMI output: ~10 GB
- Environments: **x 3**
- MLP: **x 20**

- Non-Linear: ~100 GB