

**Pavlina Mihaylova**  
**Beam Concept Modeling**

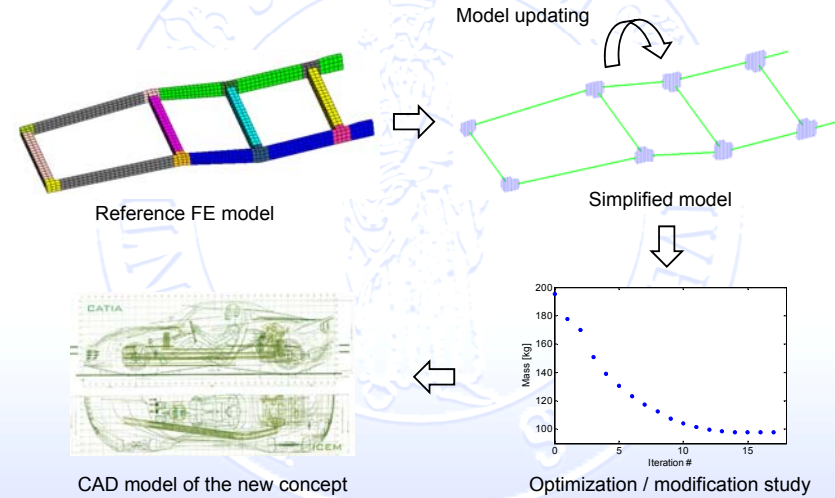
**Università degli Studi di Firenze**

**Dipartimento di Meccanica e Tecnologie Industriali**



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### NVH concept modeling



### Concept beams

Standard cross-sections

Arbitrary cross-sections

Generic cross-sections

Equivalent  
A,  $I_{yy}$ ,  $I_{zz}$ ,  
 $I_{yz}$ , J

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### Concept modeling of beams

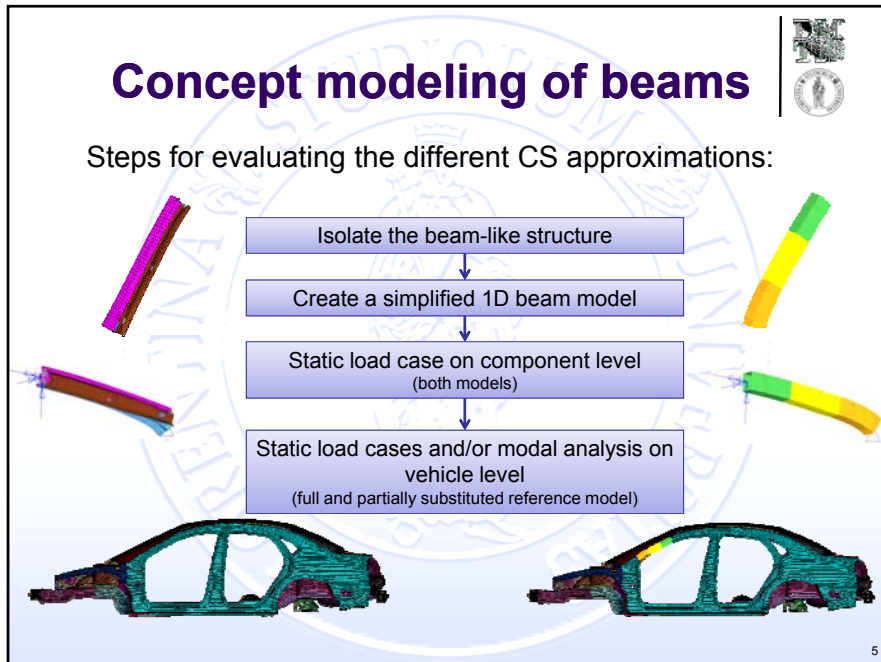
Real cross-section:

- spot welds
- stiffeners
- holes

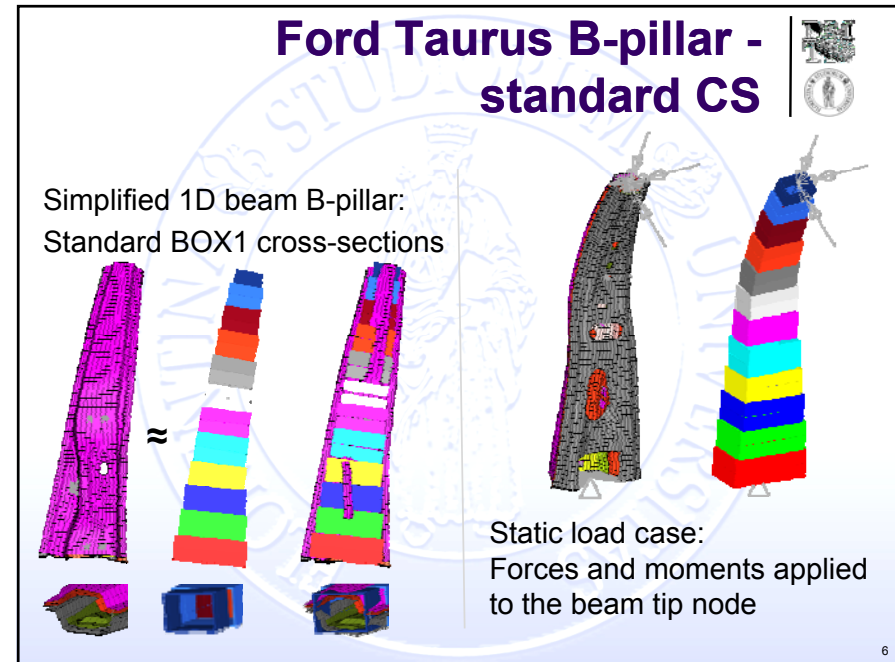
Equivalent cross-sections:

- stiffer than the real one
- A,  $I_{xx}$ ,  $I_{yy}$ ,  $I_{zz}$ ,  $I_{yz}$  – only approximate

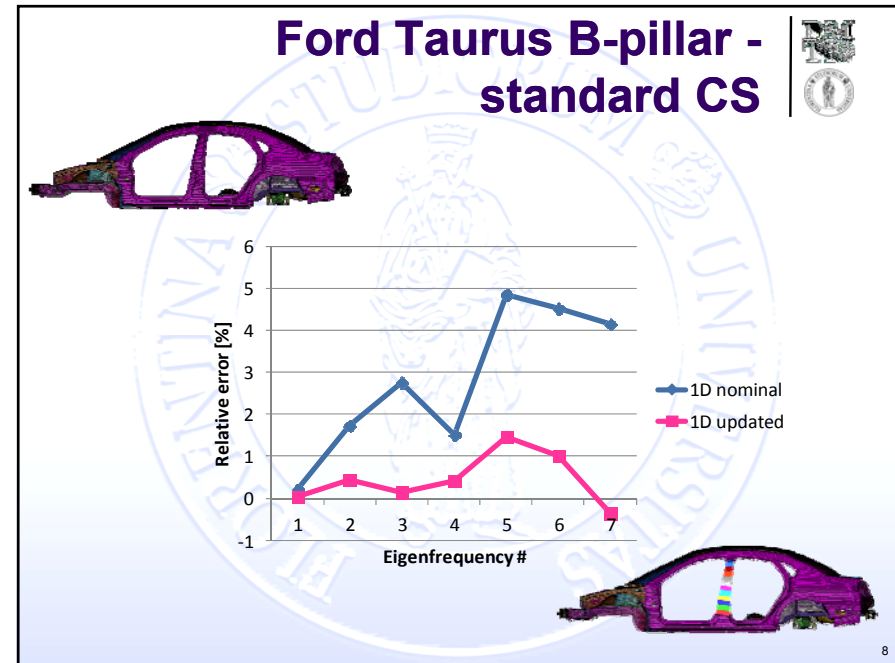
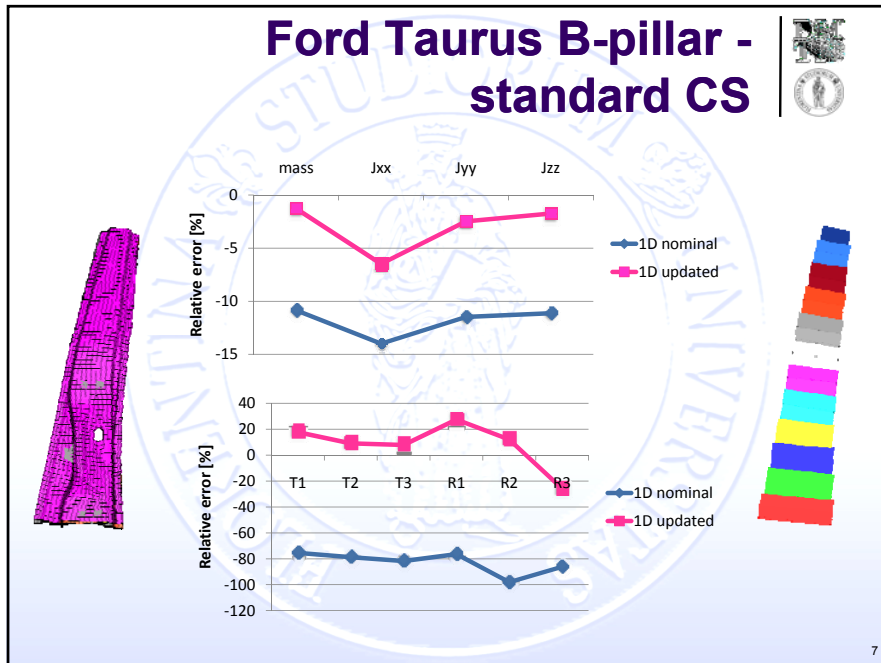
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## Model updating

- Problems with convergence
- Equivalent static behavior, but shape can differ significantly
- The transition optimized updated model >> detailed model is not straightforward

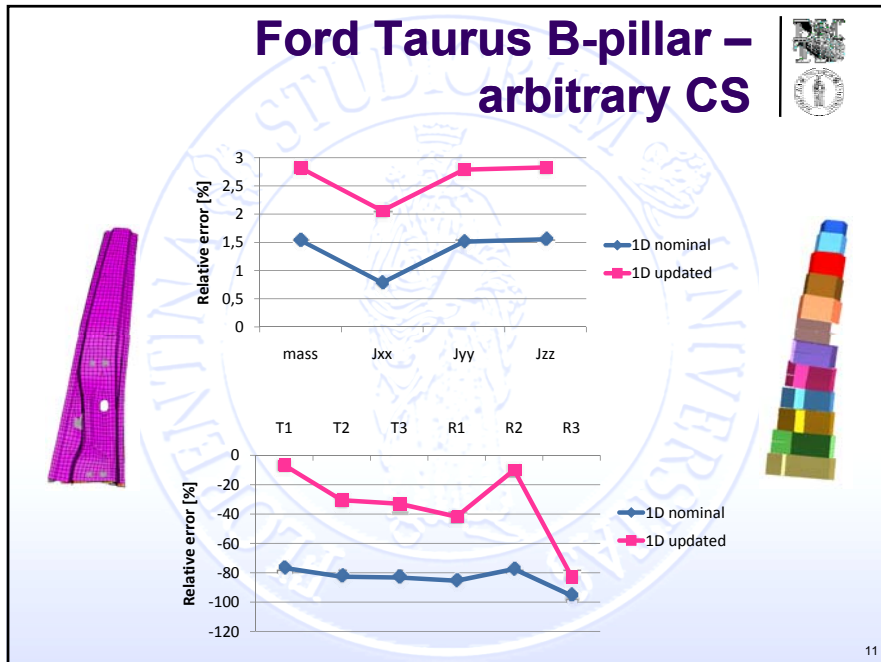
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## Ford Taurus B-pillar – arbitrary CS

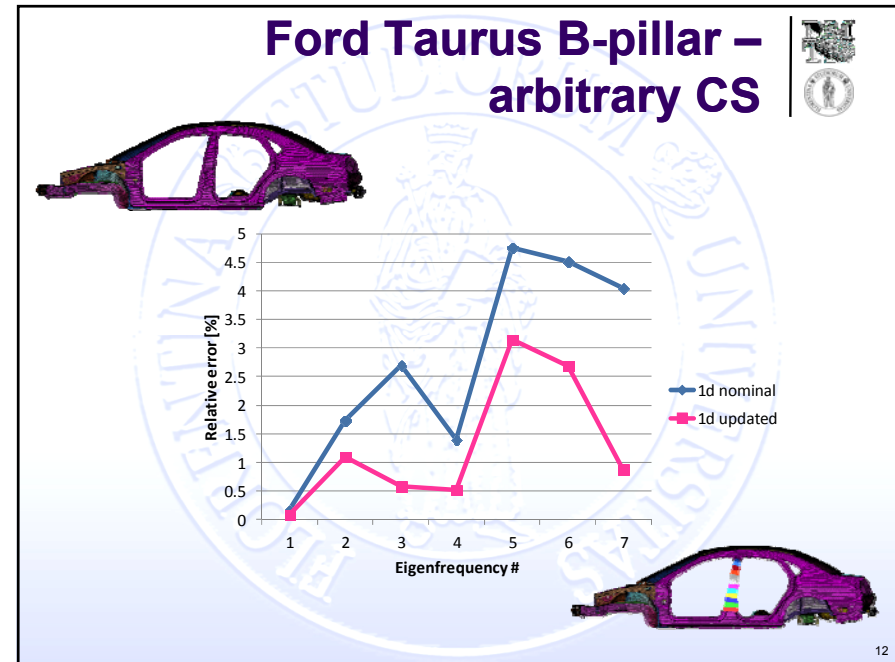
Simplified 1D beam B-pillar:  
Arbitrary cross-sections

Static load case:  
Forces and moments applied to the beam tip node

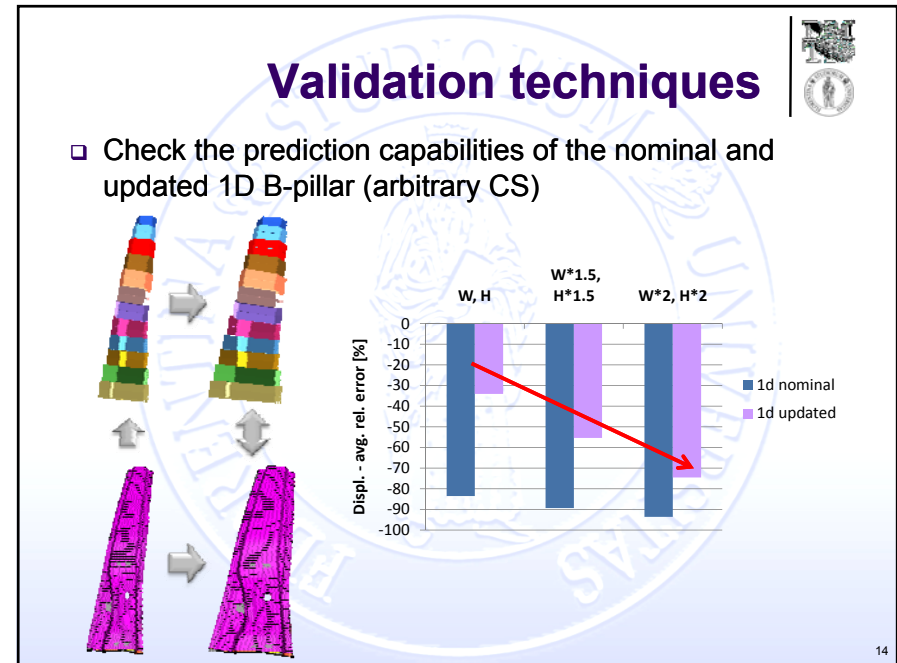
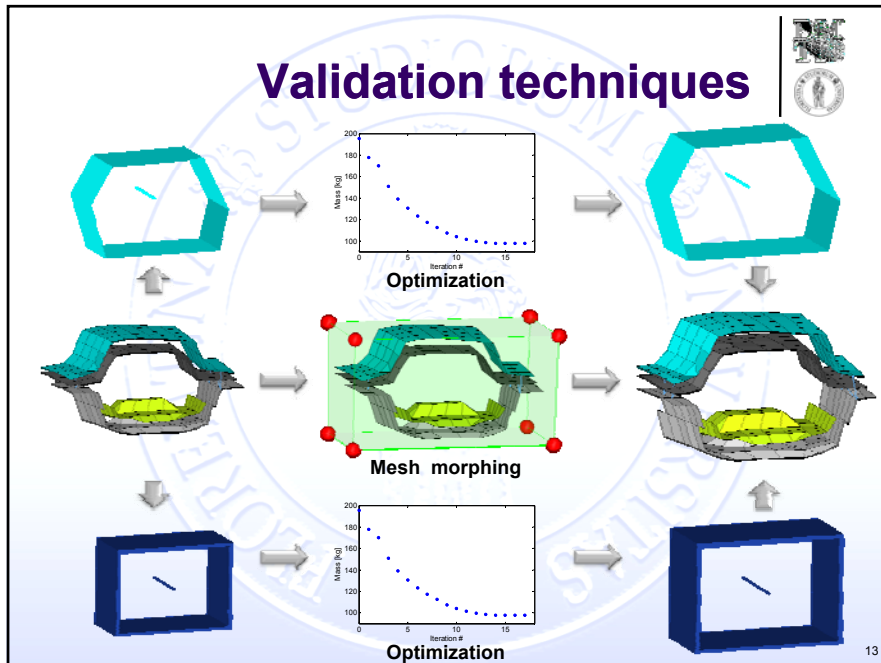
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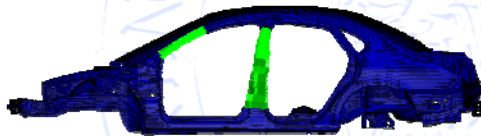


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## Model updating – pros & cons

- Pros
  - Can reduce the errors introduced with 1d beams modeling
  - Can reduce small errors due to inexperience

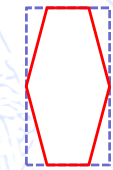
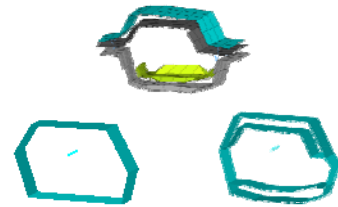


Both A- and B-pillars replaced with their 1D equivalents >>  
+4.5% average error for the first 7 eigenfrequencies

- Cons
  - Additional effort, convergence problems
  - Problems with maintaining the connection with the detailed model

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## Beam concept modeling – new approach



Equivalent PBEAM

W, H, T

A, I<sub>yy</sub>, I<sub>zz</sub>, I<sub>yz</sub>, J

A, I<sub>yy</sub>, I<sub>zz</sub>, I<sub>yz</sub>, J

- 1D beam structures with arbitrary cross-section
- Updating optional
- Bounding box optimization parameters
- Equivalent inertia properties



Equivalent PBEAM

W', H', T'

A', I<sub>yy'</sub>, I<sub>zz'</sub>, I<sub>yz'</sub>, J'

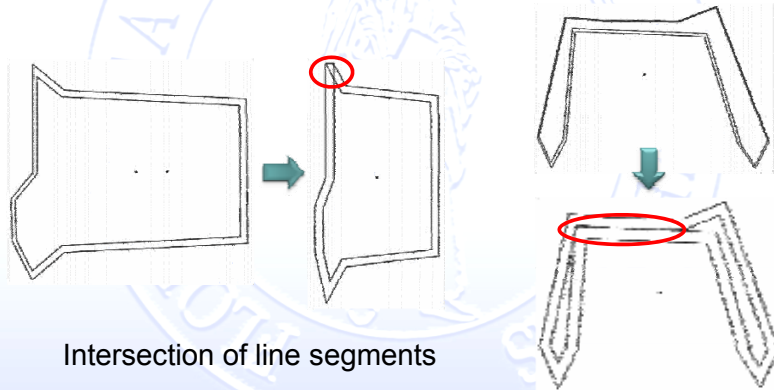
A', I<sub>yy'</sub>, I<sub>zz'</sub>, I<sub>yz'</sub>, J'

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## Beam concept modeling – new approach



- ✓ Avoiding Nastran fatal errors with arbitrary beam cross-sections



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## Beam concept modeling – new approach



- ✓ Reduce simulation times
- ✓ The gain is proportional to the number of objective function calls during optimization
- ✓ For an equal number of beam elements the gain increases with the increase of the number of cross-sectional properties

	PBMSECT	PBEAM BndBox
Time for new .dat file generation, 1000 CS	4s	2s
Time for the calculation of 1000 CS properties	4.5s	0.01s

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## Summary and next steps



- A new strategy for concept beam modeling and optimization has been defined and is to be further validated.
- Model updating is not to be excluded but must be used with caution.
- We must be always aware of the error introduced with concept beam modeling.
- Next step: concept joint modeling

