WiseTex 3.0: towards interface with custom simulation systems

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1. Introduction: WiseTex status
2. WiseTex 3.0: open integration with custom software

Integrated Design Tool

- Internal architecture of the reinforcement
- Production
- Deformation resistance and change of geometry
- Compr., Shear, Tension, Bending
- Permeability
- Performance
- Mechanical properties and damage
- Drapeability and formability
- Impregnation
- Structural analysis
Pre-History: CETKA (St-Petersburg), micromechanics (Leuven)

<table>
<thead>
<tr>
<th>Year</th>
<th>St-Petersburg</th>
<th>Leuven</th>
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<tbody>
<tr>
<td>1990</td>
<td>preliminary models</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>CETKA – DOS</td>
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<td>1992</td>
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<td>1993</td>
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<td>1994</td>
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<td>1995</td>
<td>3D coding algorithm</td>
<td>Preliminary models</td>
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<td>1996</td>
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<td>1997</td>
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<td>PhD Gommers</td>
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<td>1998</td>
<td>CETKA 3.1 “true 3D” textiles</td>
<td>PhD Vandeurzen</td>
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<td>1999</td>
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<td>FlexComp, TC3D</td>
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<td>2000</td>
<td>CETKA-KUL</td>
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History

<table>
<thead>
<tr>
<th>Year</th>
<th>Version</th>
<th>WiseTex</th>
<th>auxiliaries</th>
<th>external collaborators</th>
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<td>2000</td>
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<td>Geometrical models</td>
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<td>Compression; NCF</td>
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<td>2002</td>
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<td>In-plane: LamTex, WeftKnit (M. Moesen)</td>
<td>TexComp (G. Huysmans)</td>
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<td>FETex (S. Kondratiev)</td>
<td>FlowTex: LB</td>
<td>T. Peeters T. Mikolanda</td>
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<td>VRTex</td>
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<td>M. Zako et al</td>
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<td>2006</td>
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<td>FE manual (D.S. Ivanov)</td>
<td>B. Verleye et al M. Griebel et al</td>
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<td>2007</td>
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<td>FlowTex: FD</td>
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<td>M. Zako et al</td>
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<td></td>
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<td>P. de Luka et al</td>
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<td>3.0</td>
<td>XML exchange; command line version</td>
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<td>Ch. Hanh et al</td>
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</table>
WiseTex worldwide

licences:
- industrial (6)
- university (30)

WiseTex: Virtual textiles/composites

Models of internal geometry
- WiseTex
- LamTex
- Virtual reality
- Finite elements

Micro-mechanics
- TexComp
- Flow
- FlowTex

Micro-mechanics

S.V. Lomov 10.04.2012 Osaka University
1. Introduction: WiseTex status
2. WiseTex 3.0: open integration with custom software
WiseTex 3.0: data open to a user

**WiseTex 3.0:**
- open XML input and output formats
- *command line* version

**New possibilities:**
- easy integration:
  - upstream, with user-defined process models (e.g., braiding process)
  - downstream, with user-defined models of composite (e.g., meso-FE)

**Scripting:**
- parametric studies
- look-up tables (e.g., shear angle)

**.fabx file format (1)**

```
WiseTex-XML
   | Fabric
   |   | Data
   |   |   | Title
   |   |   | Built
   |   |   | Alpha
   |   |   | X
   |   |   | Y
   |   |   | Z
   |   |   | pm
   |   |   | py
   |   |   | pz
   | Yarns
   |   | YarnInFabric
   |   |   | Item-1
   |   |   |   | AverD1
   |   |   |   | AverD2
   |   |   |   | AverV1
   |   |   |   | AverSectionData
   |   |   |   | StructurePosition
   |   |   | Item-2
   |   |   | Item-3
   |   |   | Item-4
   |   | Yarn
   |   | YarnLength
   |   | Parameters
   |   |   | Mass
   |   |   | Density
   |   |   | V
   |   |   | V2
   |   |   | V3
   |   |   | V4
   |   | Fibers
```

**XML:** textile data

**XML:** fabric geometry

**custom software**
.fabx file format (2)

WiseTex 3.0: scripting

WiseTex 3.0:
- open XML input and output formats
- "command line" version

New possibilities:
- easy integration:
  - upstream, with user-defined process models (e.g., braiding process)
  - downstream, with user-defined models of composite (e.g., meso-FE)
- scripting:
  - parametric studies
  - look-up tables (e.g., shear angle)
WiseTexCL and TexCompCL scripts

WiseTexCL.exe <input file path> <output name and extension>
[<mode>:<parameters>] [nl] [ns]
WiseTexCL "input.wfax" "output.fabx"
WiseTexCL "input.wfax" "output.fabx" build:10
WiseTexCL "input.wfax" "output.fabx" compress: 0.5; 0.001
WiseTexCL "input.wfax" "output.fabx" inplane: 30;
0,0,1,0.1; 0,-1,0.1; 45,-1,0

TexCompCL.exe <WiseTex file path> <matrix XML file path>
<stiffness CSV file path> [VF:<fibre volume fraction>][CS:<phi>]/[nl]/[ns]
TexCompCL.exe "composite.wfax" "epoxy.xml" "Results.csv" /nl

Multilevel structural analysis
WiseTex/TexCompCL scripts

XML: parameters of the textile reinforcements

User interface (GUI?)

Command script

XML: full description of the reinforcement model

Material stiffness

Code and data formats – WiseTex/TexComp Custom software

custom software

Possible integration with forming simulation

for all elements
WisTeXCL braid.b2dx sheared.fabx in_plane:element.GAMMA
TexCompCL sheared.fabx epoxy.xml C.csv
store C in element
end for

element: shear
angle GAMMA

material: stiffness
matrix C

structural analysis

forming simulation

WiseTex

braid.b2dx
Conclusion

New WiseTex 3.0 version provides the user with possibility to integrate WiseTex, TexComp and FlowTex code into custom software.

The XML data exchange format will be used in new version of MeshTex software of Osaka University.