

MODELLIERUNG VON GEFLECHTEN FÜR COMPOSITES UND DEREN MECHANISCHES VERHALTEN

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Geometrische Modelle

STAND DER TECHNIK

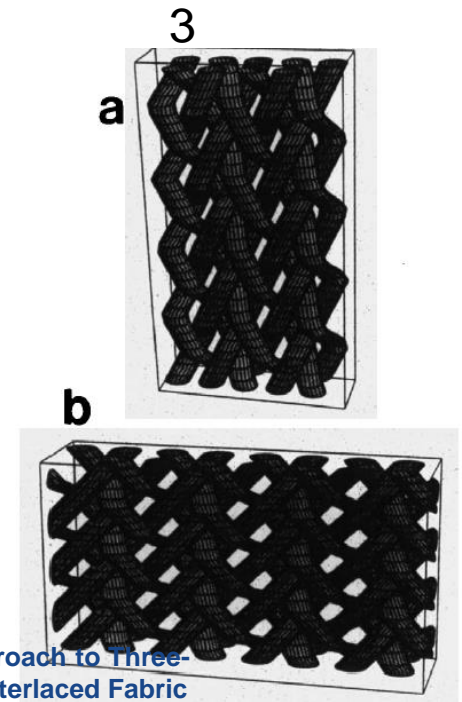
Geometrical Models

Based on GEOMETRICAL relations about
the positions of some key- points of
the yarns

😊 Fast

☹ Not accurate

☹ Not enough variability



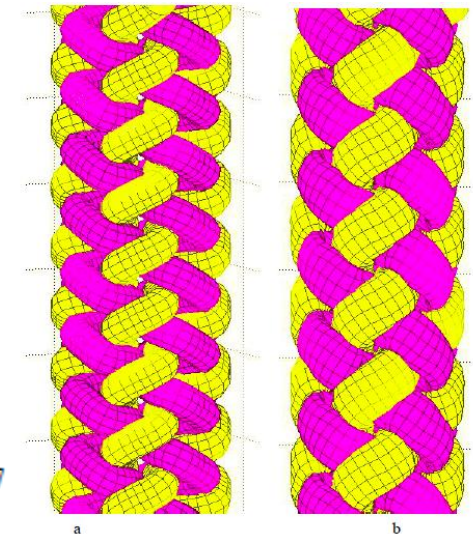
Liao, T., Adanur, S.: A Novel Approach to Three-Dimensional Modeling of Interlaced Fabric Structures. Textile Research Journal 68(11), 841–847 (1998)

MODEL GENERATOR FOR TUBULAR BRAIDED FABRICS

Y. Kyosev

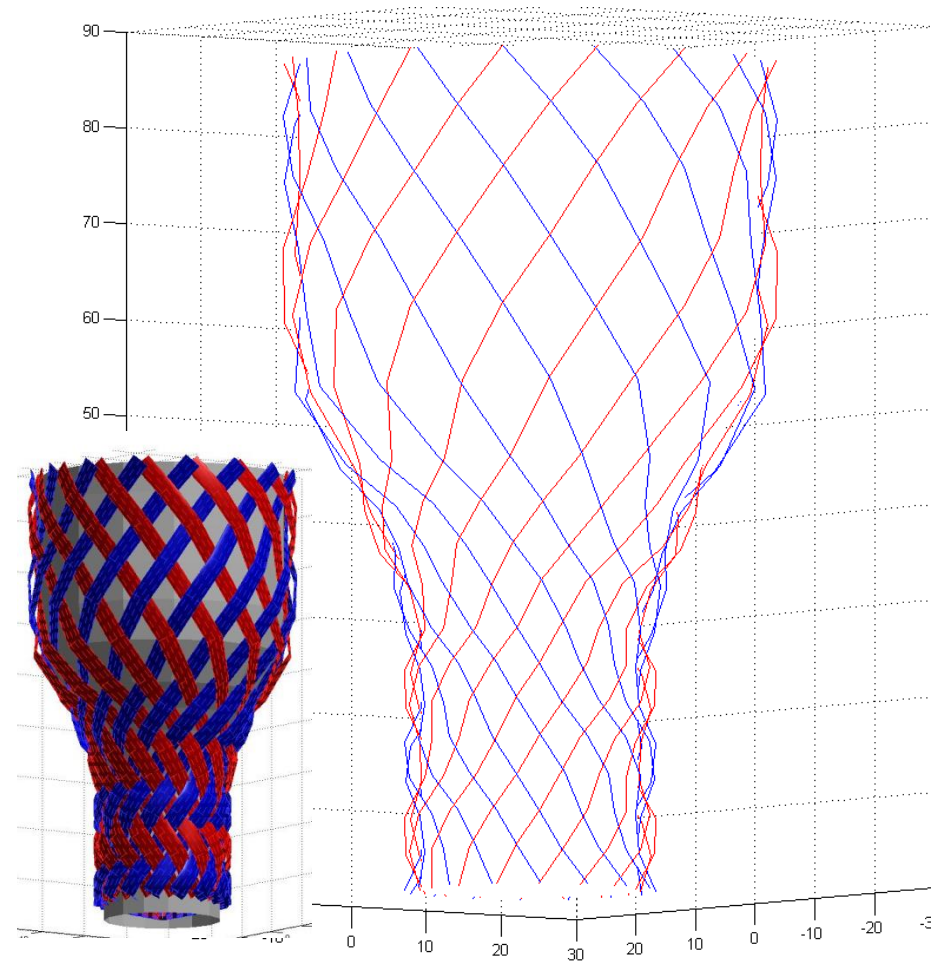
Niederrhein University of Applied Sciences, Webschulstr. 31, 41065-Mönchengladbach, Germany,
e-mail: yordan.kyosev@hs-niederrhein.de

“FINITE ELEMENT MODELLING OF TEXTILES AND TEXTILE COMPOSITES”, ST-PETERSBURG, 26-28 SEPTEMBER 2007



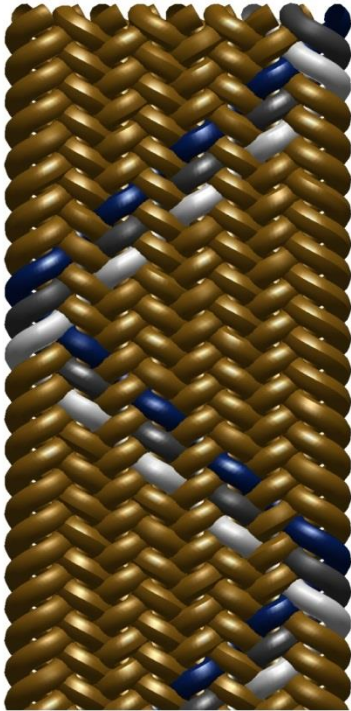
Geometrical Models ff.

**Geometrical model
for overbraiding of
bodies with
rotational symmetry**



Grave, G., Zimmermann, K., Drechsler, K., Rathjens, A., Kyosev, Y.: Simulation of 3D overbraiding – solutions and challenges. In: Chen, X. (ed.) Second World Conference on 3d Fabrics and their Applications (2009)

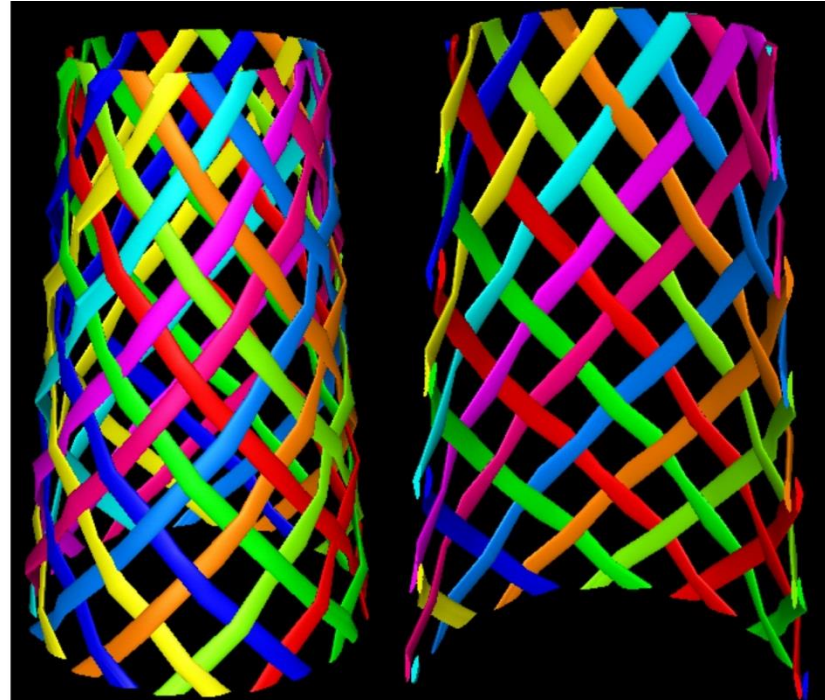
Geometrical models



a



b



c

d

Kyosev, Y.; www.texmind.com

Kyosev, Y., Risicato, J.-V., et. al.: Modeling of Braided Fabrics for Composite Reinforcement Parts with Rotational Symmetry. In: Proceedings, Dresden (2008) based on TexGen Software

Geometrical Models f.

$$r_0 = k_2 \frac{2p \cos \alpha}{\beta} \quad (44)$$

$$r(\theta) = -\frac{a}{4} + \frac{3a}{4} \sin\left(\frac{2\pi}{\beta}\theta + \frac{3\pi}{2}\right) \quad (45)$$

$$X_i = (r_0 + r(\theta)) \cos(-\theta - (i-1)\beta), i = 1, 2 \dots n \quad (46)$$

$$Y_i = (r_0 + r(\theta)) \sin(-\theta - (i-1)\beta), i = 1, 2 \dots n \quad (47)$$

$$Z_i = r_0(\tan \alpha)\theta, i = 1, 2 \dots n \quad (48)$$

3D geometrical modelling of tubular braids

Tuba Alpyildiz

Textile Research Journal 2012 82: 443 originally published online 8 November 2011

DOI: 10.1177/0040517511427969

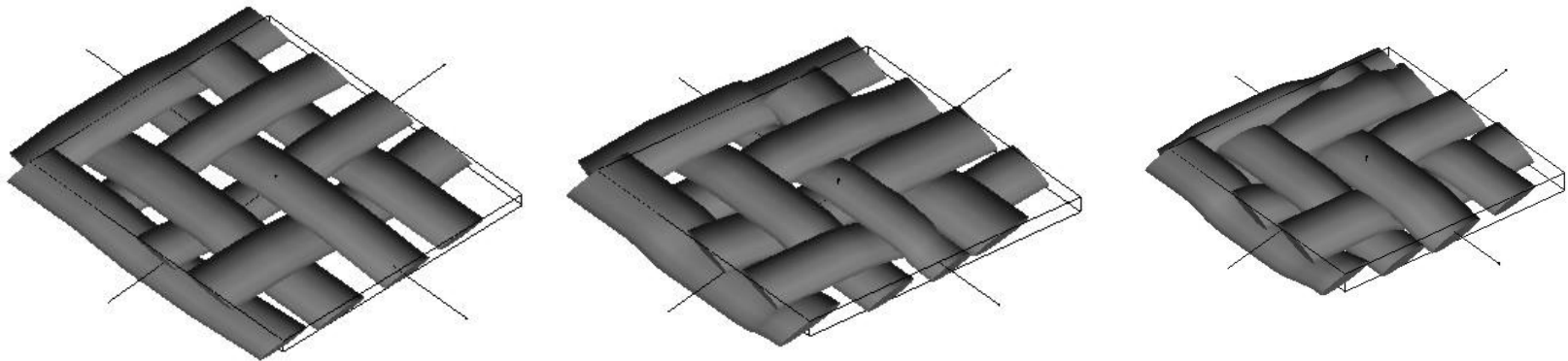


Unit Cell Geometry

Unit Cell Geometry using WiseTex

The calculations are considering the mechanics of the yarns

The goal of the software is to create good **unit cells configuration**, not to support the braiding process simulation and for such tasks is not applicable

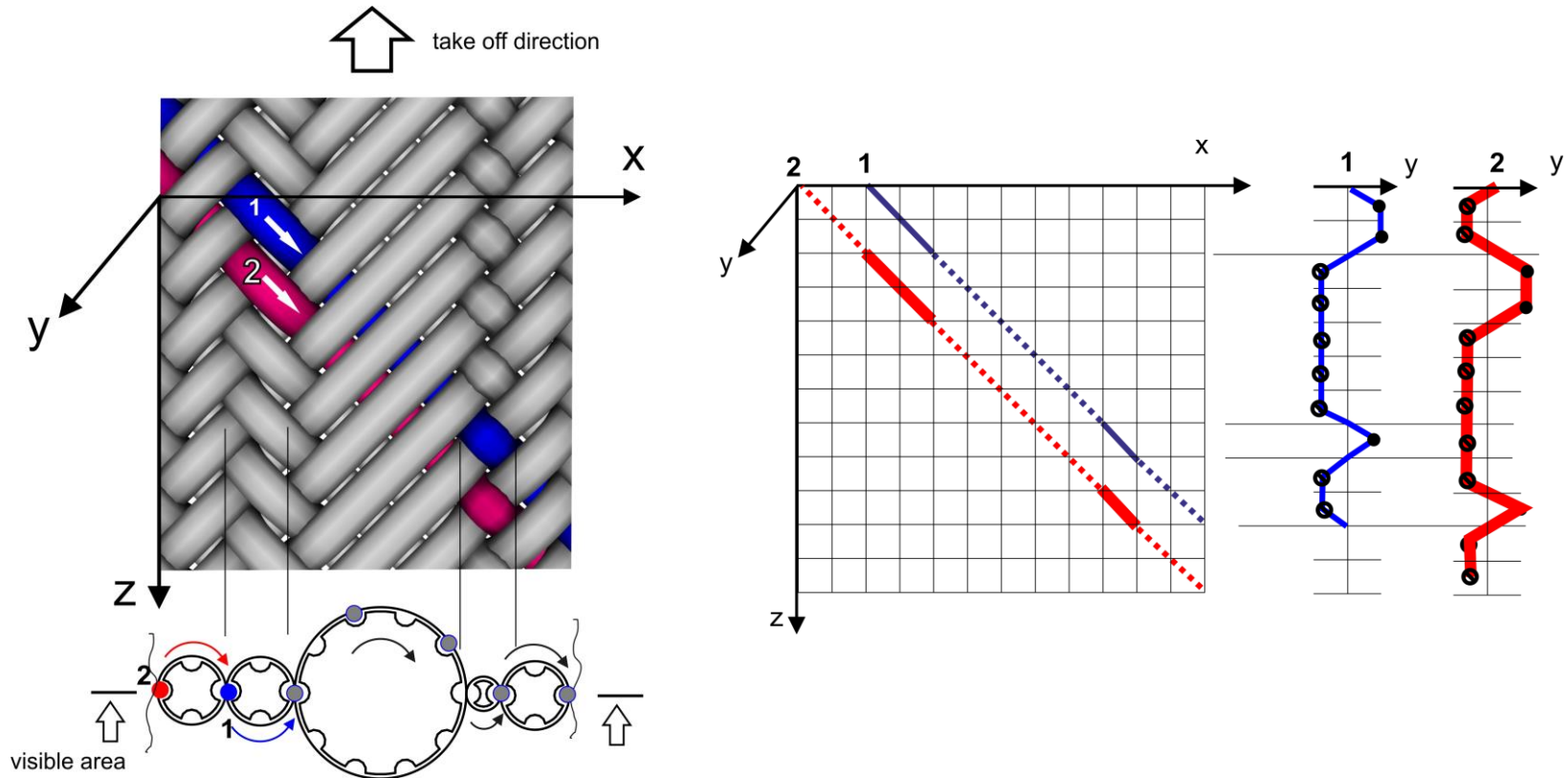


Cells generated by WiseTex (KU Leuven)

Geometrische Modelle

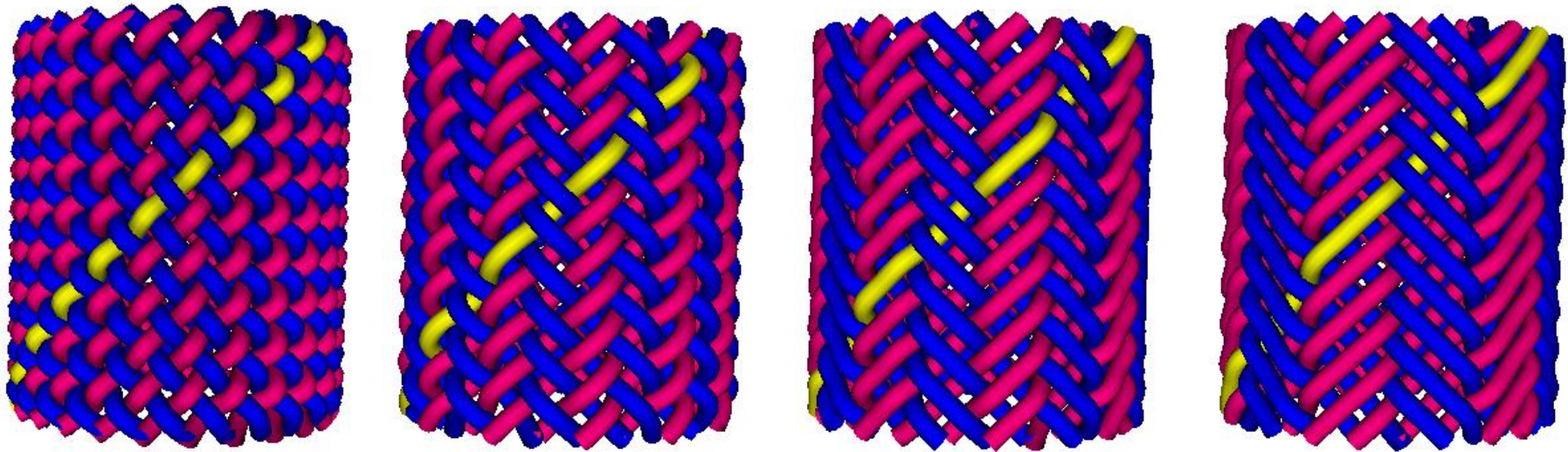
EIGENE ENTWICKLUNG

Allgemeines geometrisches Model



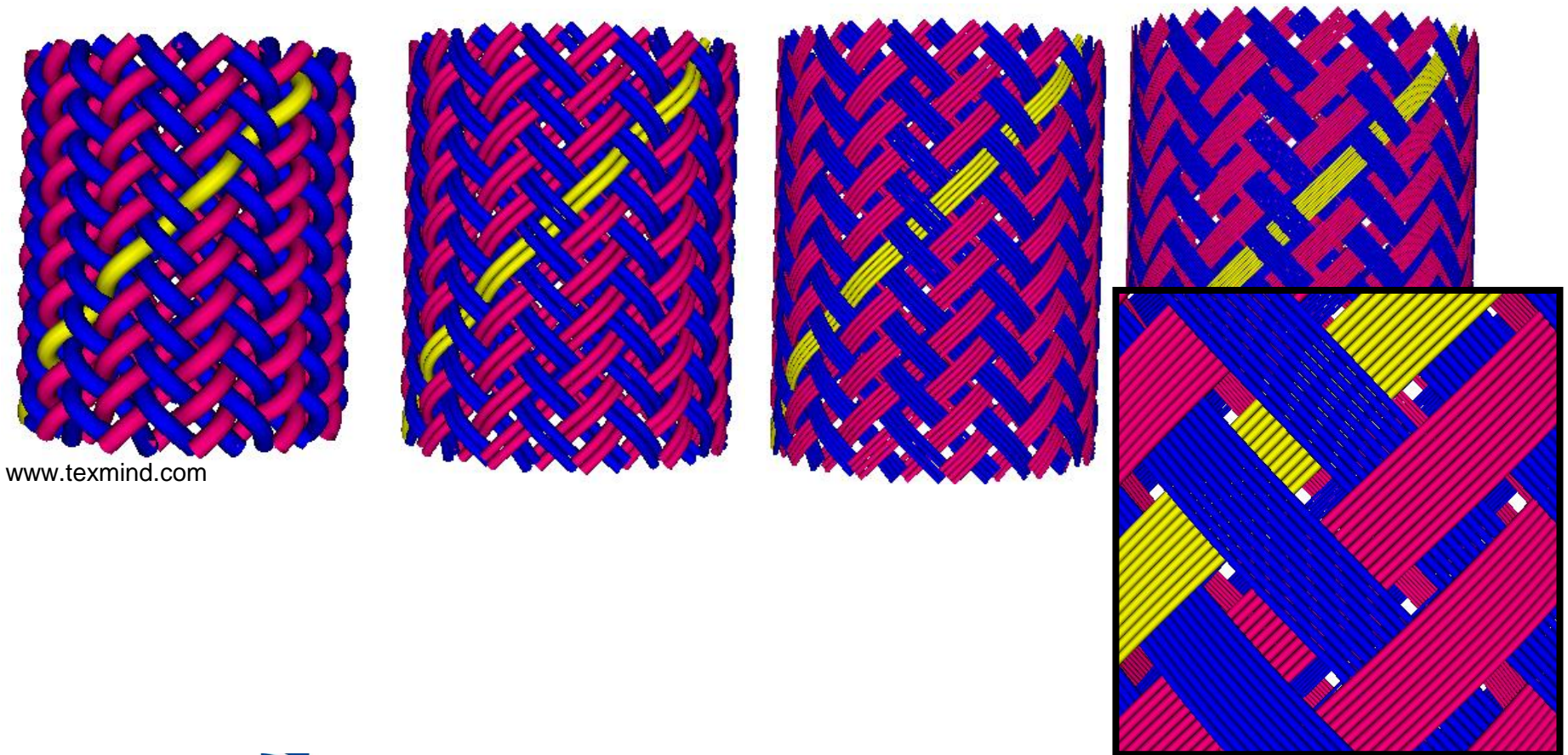
Kyosev, Y., Generalized geometric modeling of tubular and flat braided structures with arbitrary floating length and multiple filaments, *Textile Research Journal*, 2015, online first, DOI: 10.1177/0040517515609261

Flechtigkeit



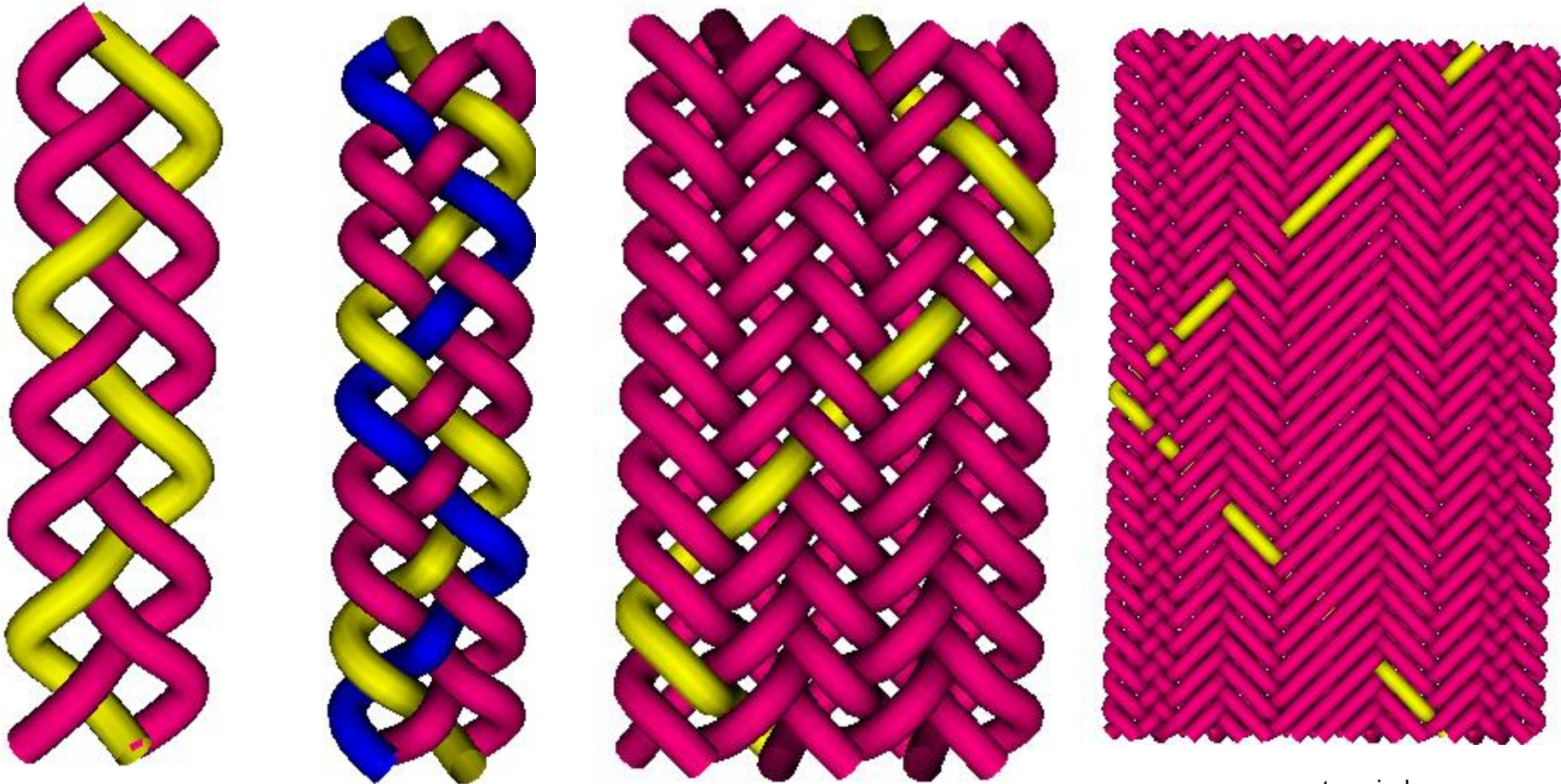
www.texmind.com

Fädigkeit



www.texmind.com

Flachgeflechte mit unterschiedlichen Bereichen

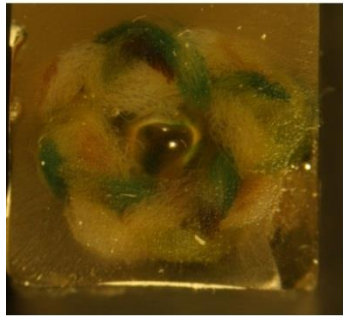


www.texmind.com

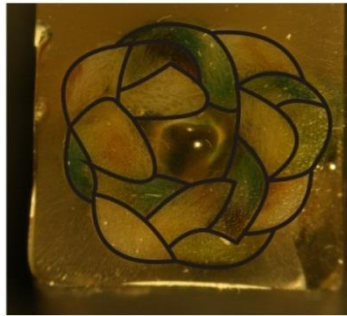
Composites: Multifilament Garne (Tows, Rowings)



Cross section form of multifilament yarns in tubular braids



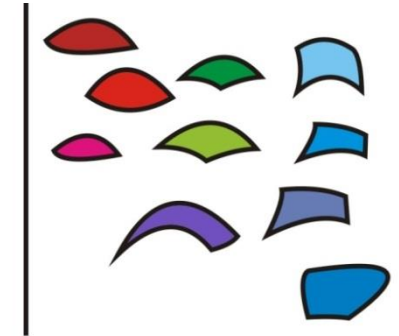
a



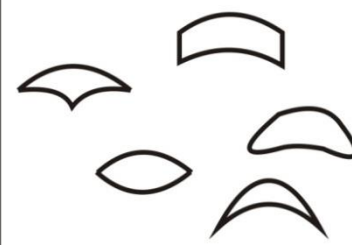
b



c



d

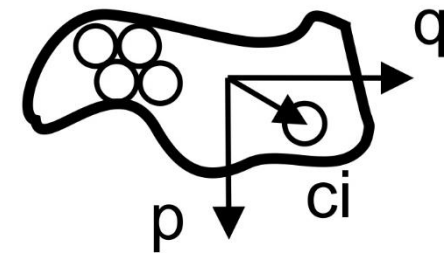


e

Anna Rathjens: Analyse von Garnquerschnittsänderungen von umflochtenen Strukturen für Verbundwerkstoffe. Study work, Hochschule Niederrhein (2009)

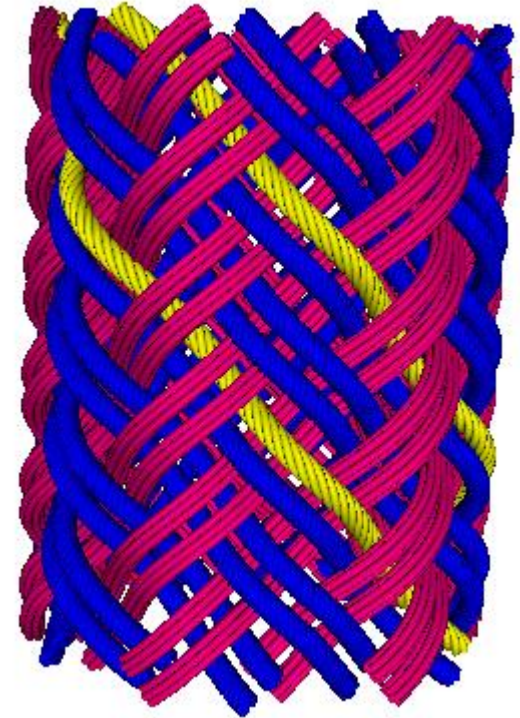
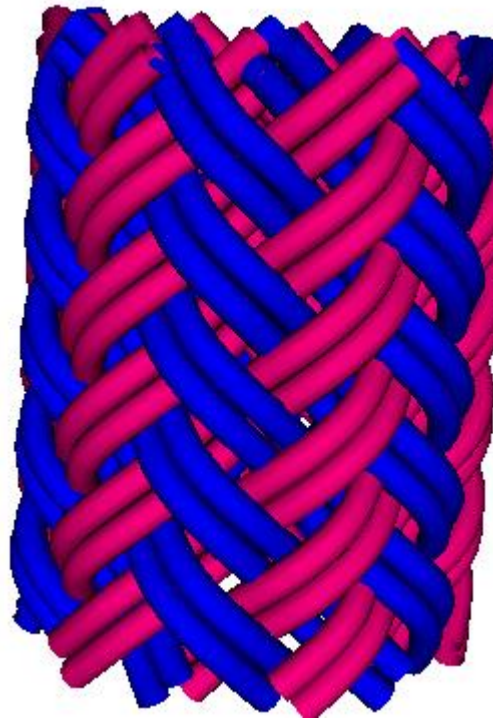
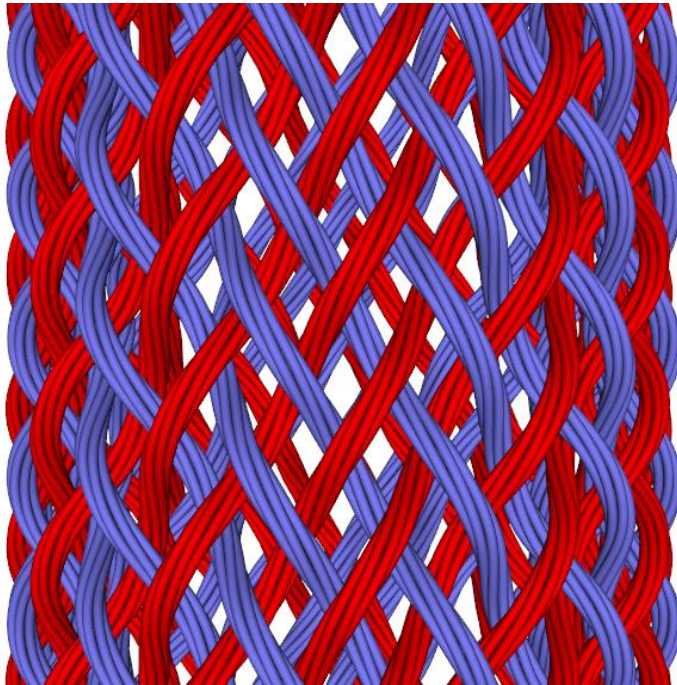
Querschnitt des Garnes - Definition

Mehreren Horizontalen Lagen definierbar



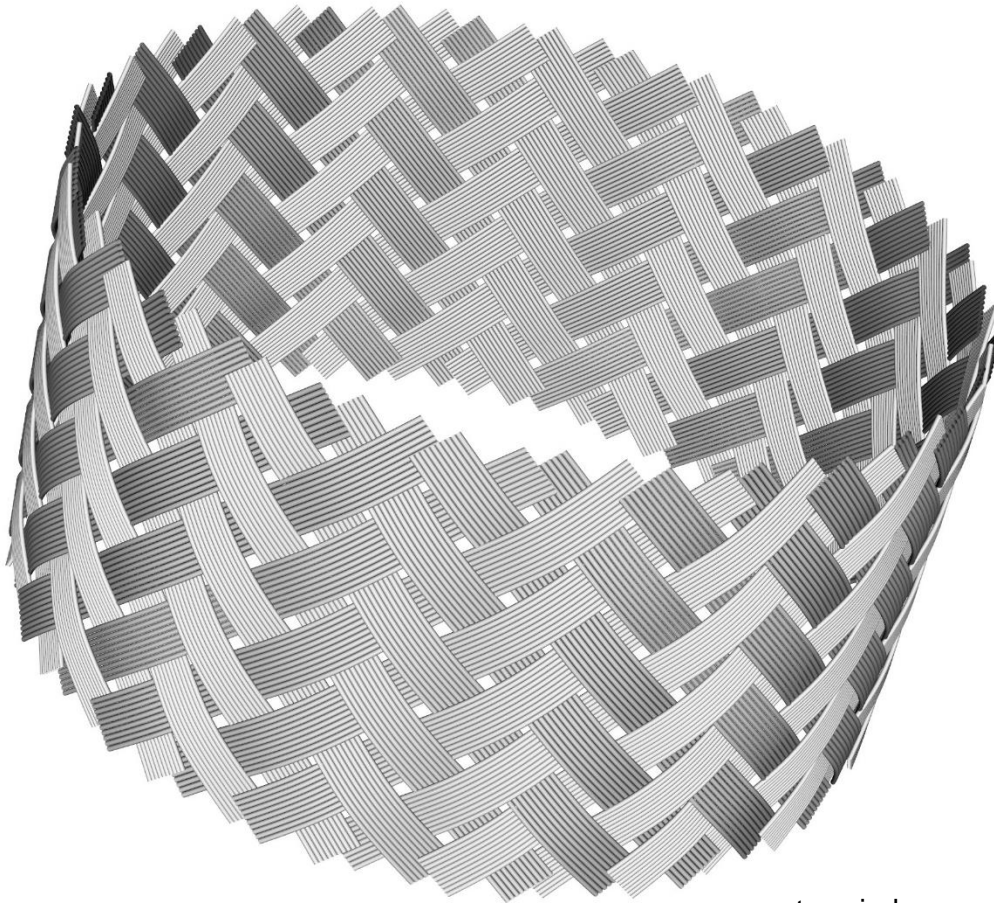
	Y nominmal	X shift	Number Fil...	Filament D...	Distance b...
1	-0,2	0	9	0,2	0
2	0	0	10	0,2	0
3	0,2	0	9	0,2	0

Multifilament Garn



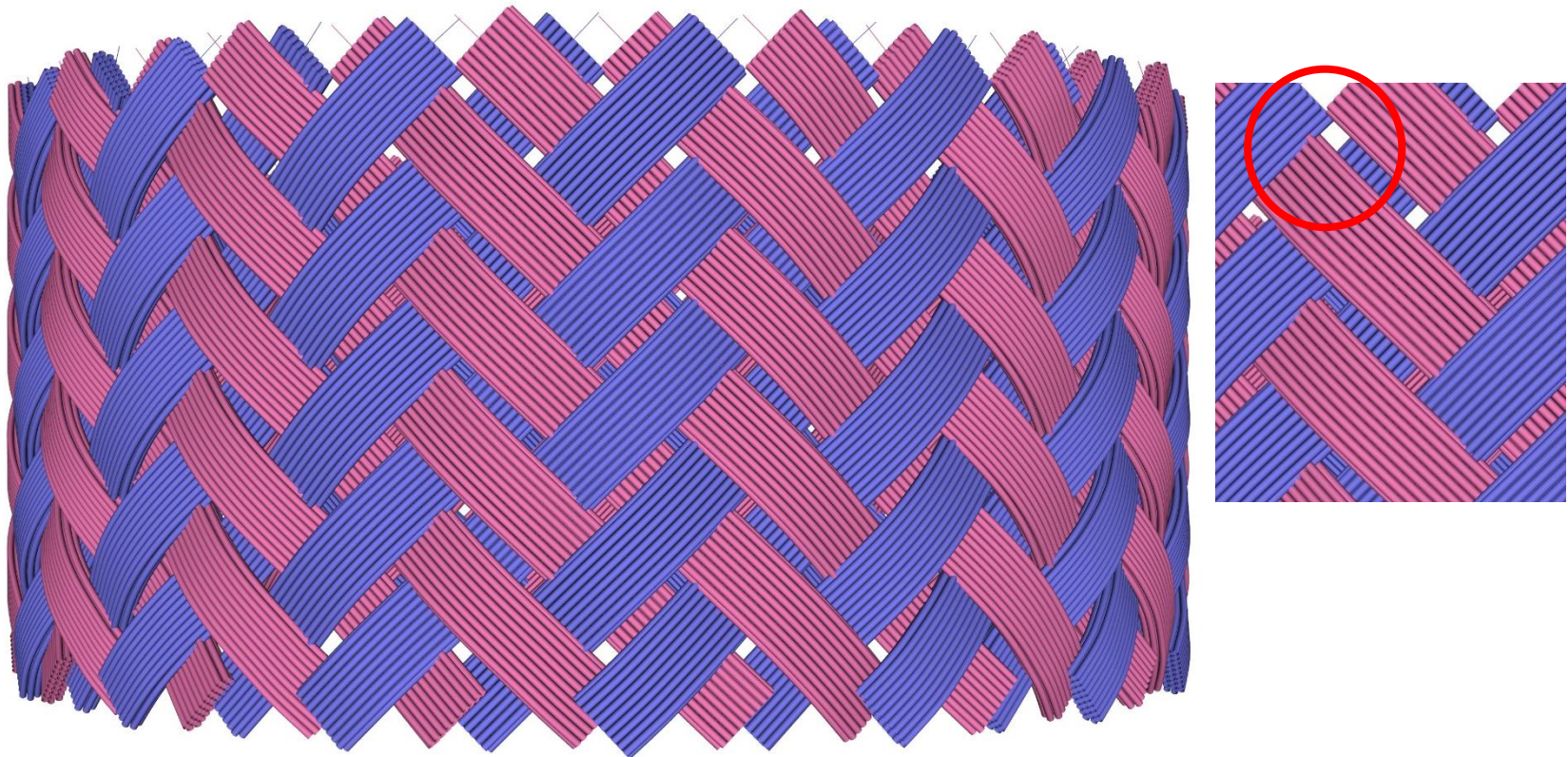
www.texmind.com

Mehrfädig



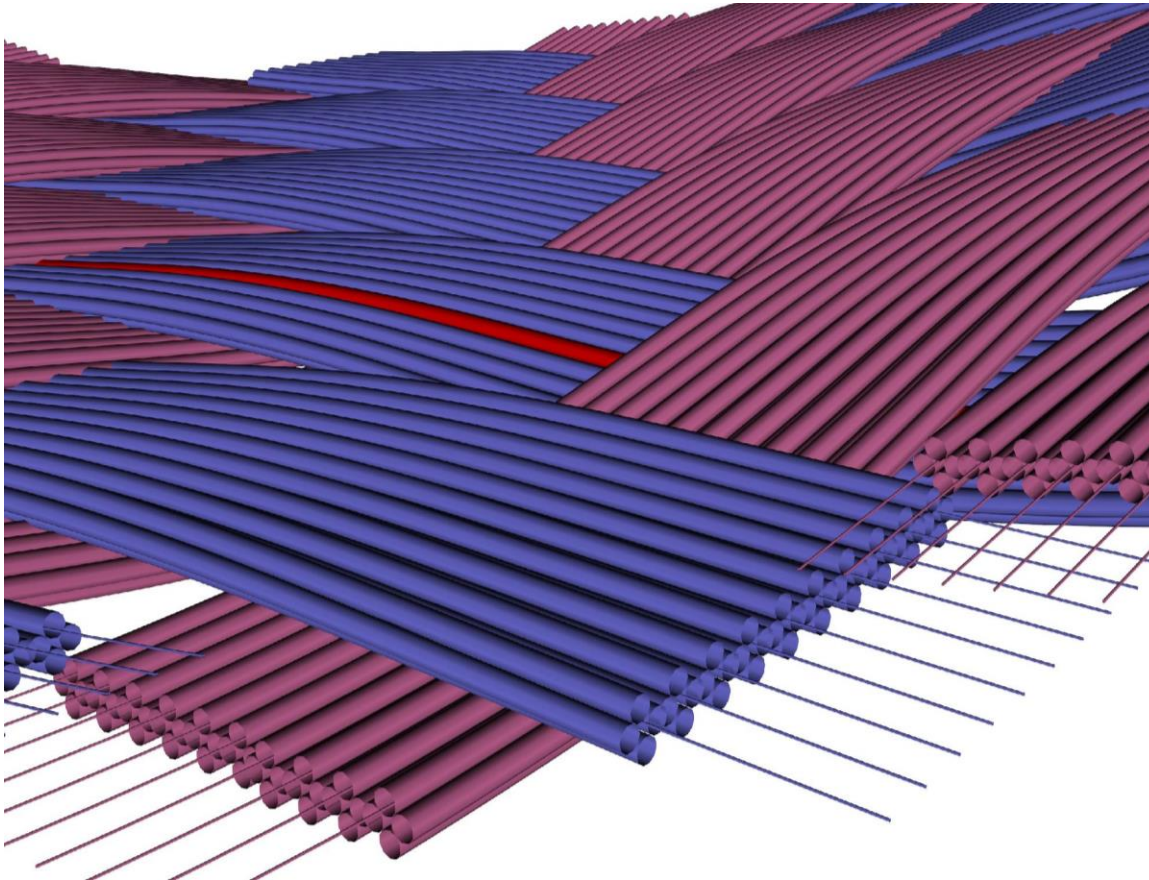
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Problem when using fast interpolations - Collision



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Clean geometry



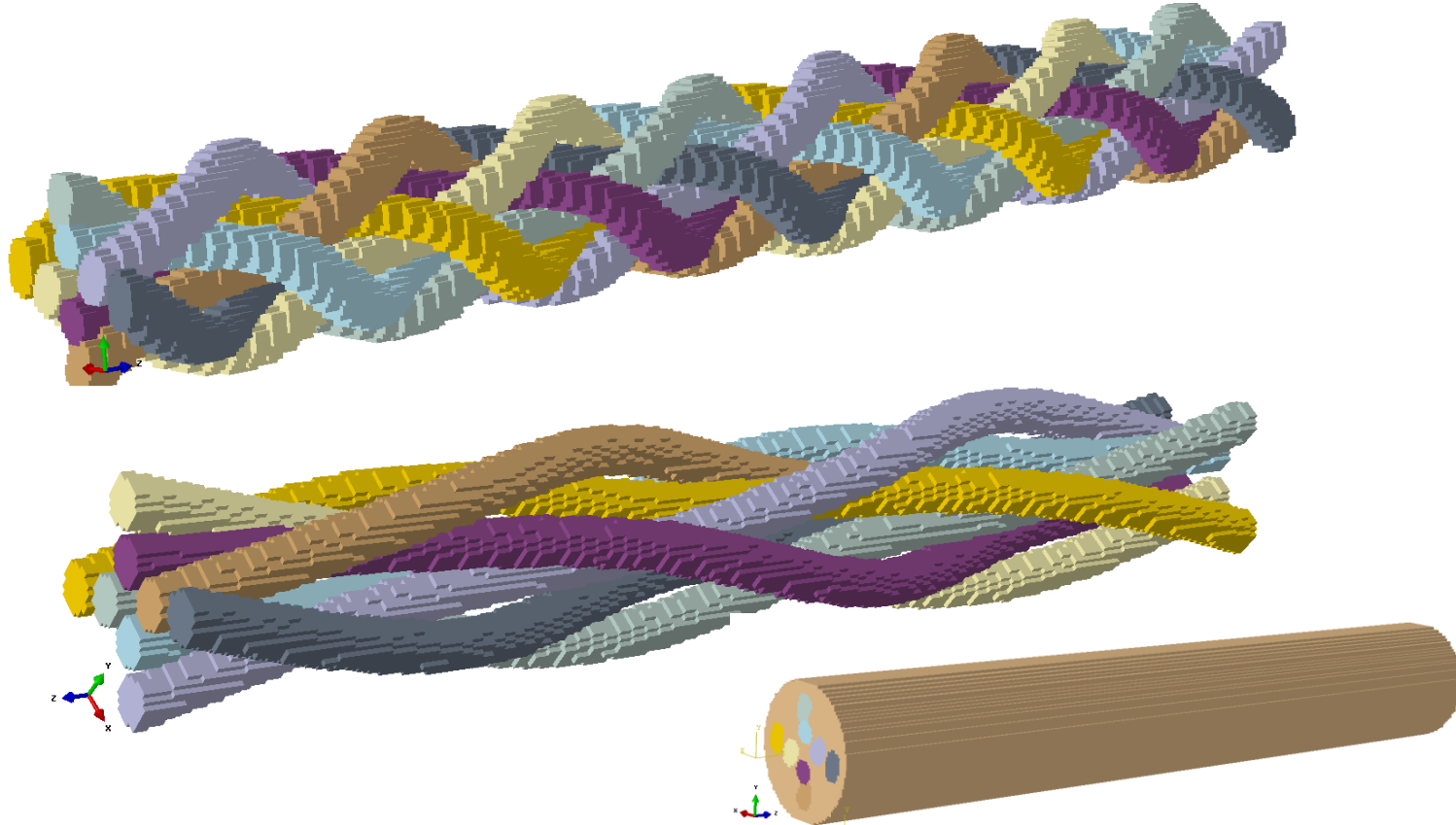
www.texmind.com

Geometrische Modelle

EXPORT UND

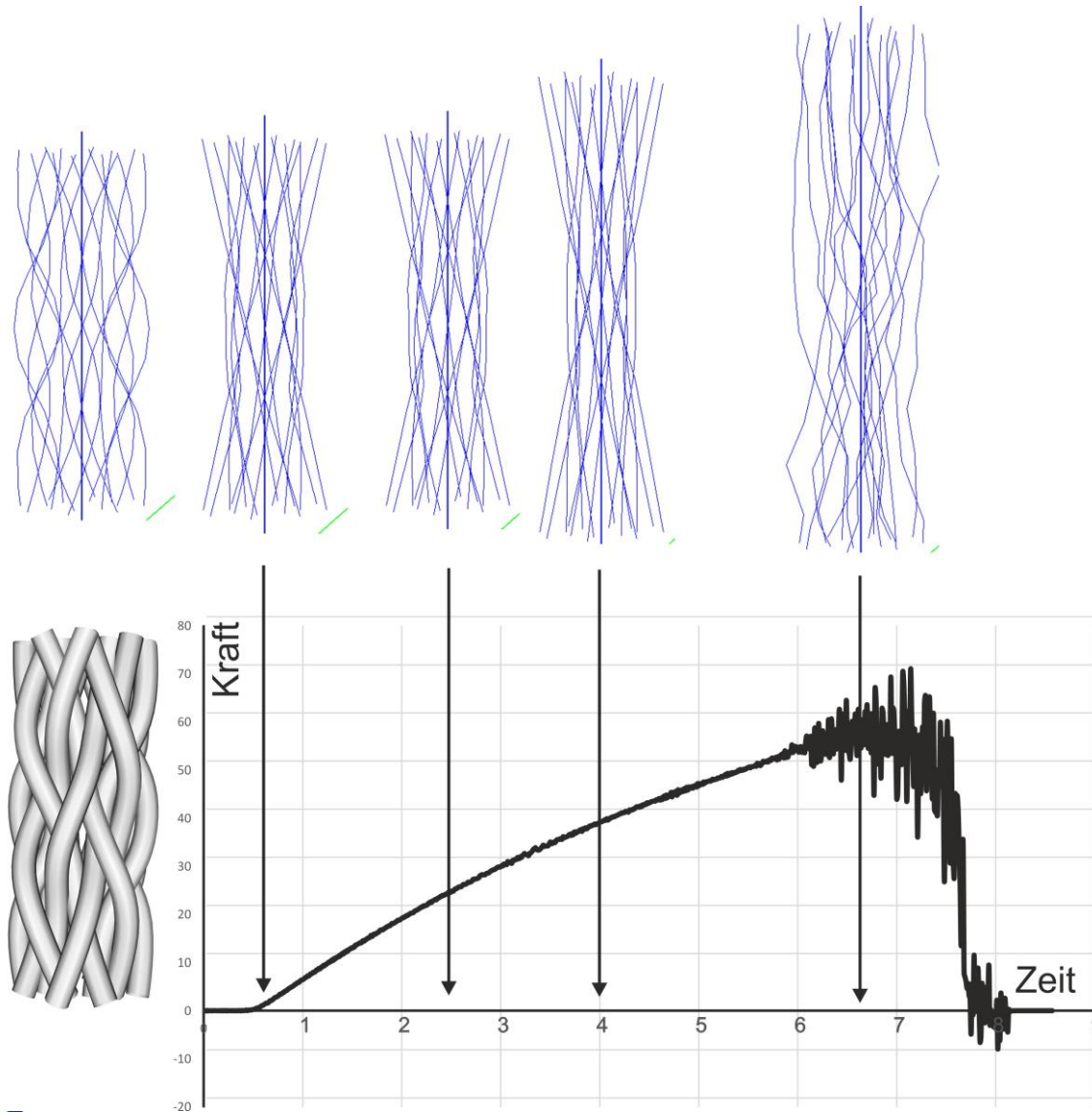
BERECHNUNGEN

Voxelisation



Kyosev, Y.K., Hello, G., Reinsch Jana, Aboura, Z., Schneider, J.: DETERMINATION OF THE MECHANICAL PROPERTIES OF BRAIDED COMPOSITE BEAMS WITH EXPERIMENTAL AND NUMERICAL METHODS. In: Bogdanovich, A.E. (ed.) Proceedings. TEXCOMP-12 CONFERENCE, RALEIGH, NC, U.S.A., 26-29 MAY 2015 (2015)

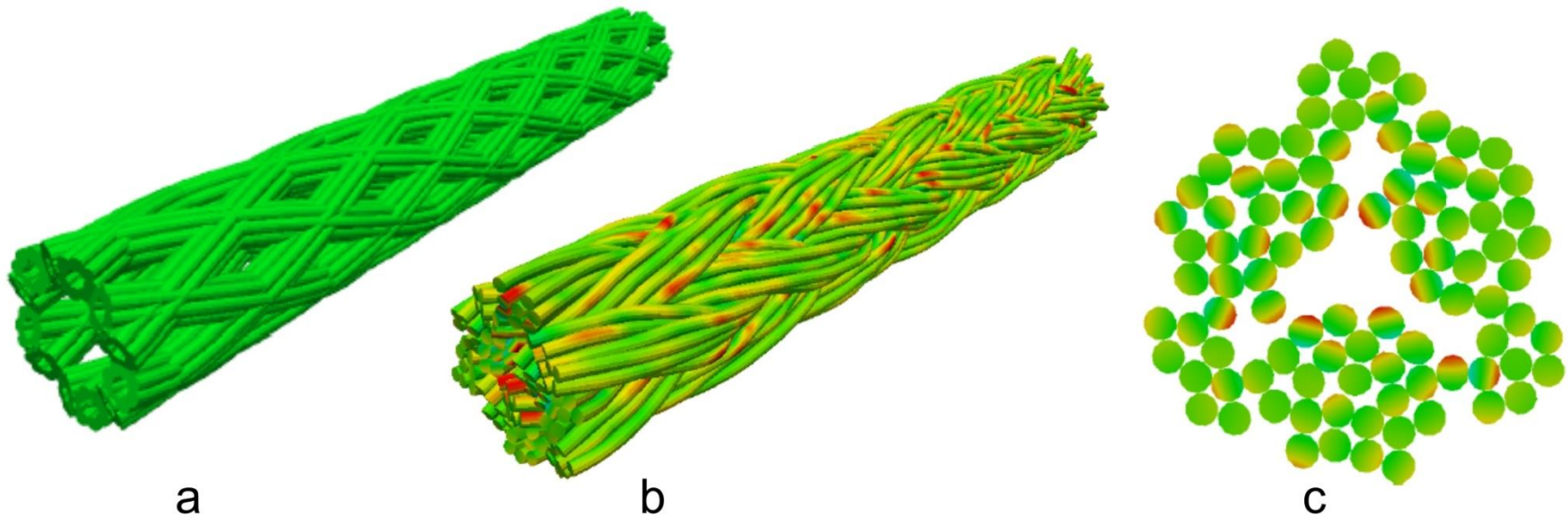
Explicite FEM mit Stab-Elemente



Geometrische Modelle

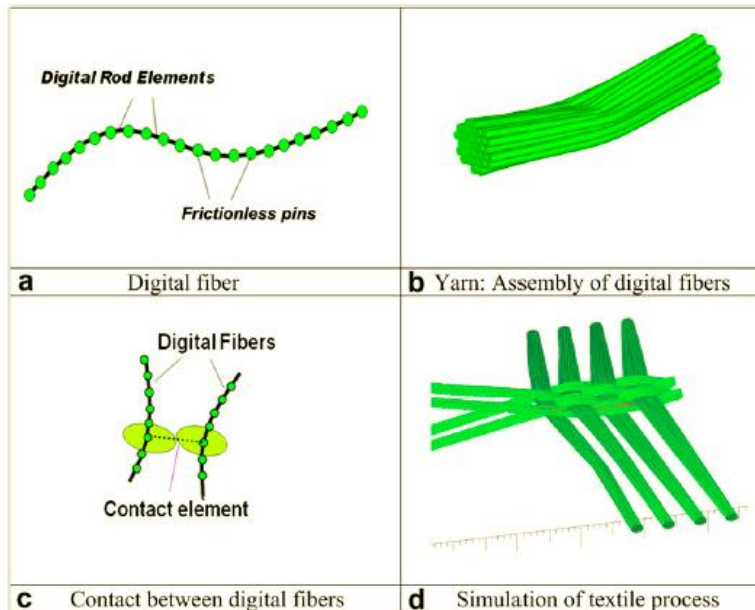
WEITERE MÖGLICHKEITEN FÜR MECHANISCHE BERECHNUNGEN

Balkenelemente mit FEM durch Relaxation



Do Vuy, T., Durville, D., Davies, P.: Simulation of the Bend-Over-Sheave Behaviour of Braided Synthetic Ropes. In: Holzapfel, G.A., Ogden, R.W. (eds.) ESMC 2012. Book of abstracts. Technischen Universität Graz, Graz (2012)

„Digital element“ method



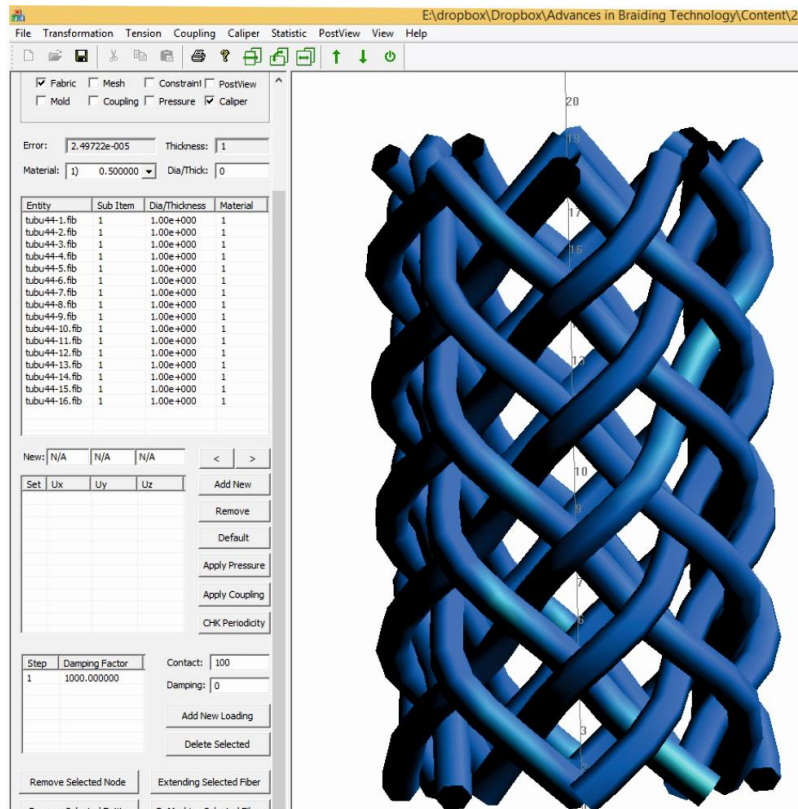
Digital element approach for simulating impact and penetration of textiles

Youqi Wang^{a,*}, Yuyang Miao^a, Daniel Swenson^a, Bryan A. Cheeseman^b, Chian-Feng Yen^b, Bruce LaMattina^c

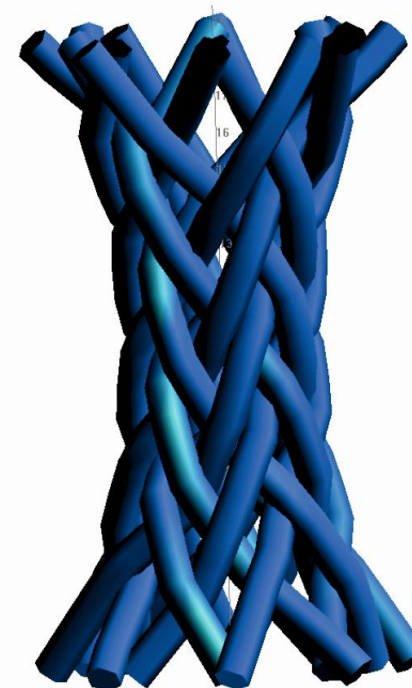
Zhou, E.; Mollenhauer, D.; Larve, E. (2009): A realistic 3-D textile geometric modeling". In: ICCM-17 : 17th International Conference on Composite Materials. Edinburgh, 27.-31.07.2009. London: IOM Communications.

Zhou, E.; Sun, X.; Wang, Y. (2004): Multi-Chain digital element analysis in textile mechanics. In: *Composite Science and technology* 64 (2), S. 239–244.

Braid Data > TexMind Braider > Export > VMTS > Relaxation



a



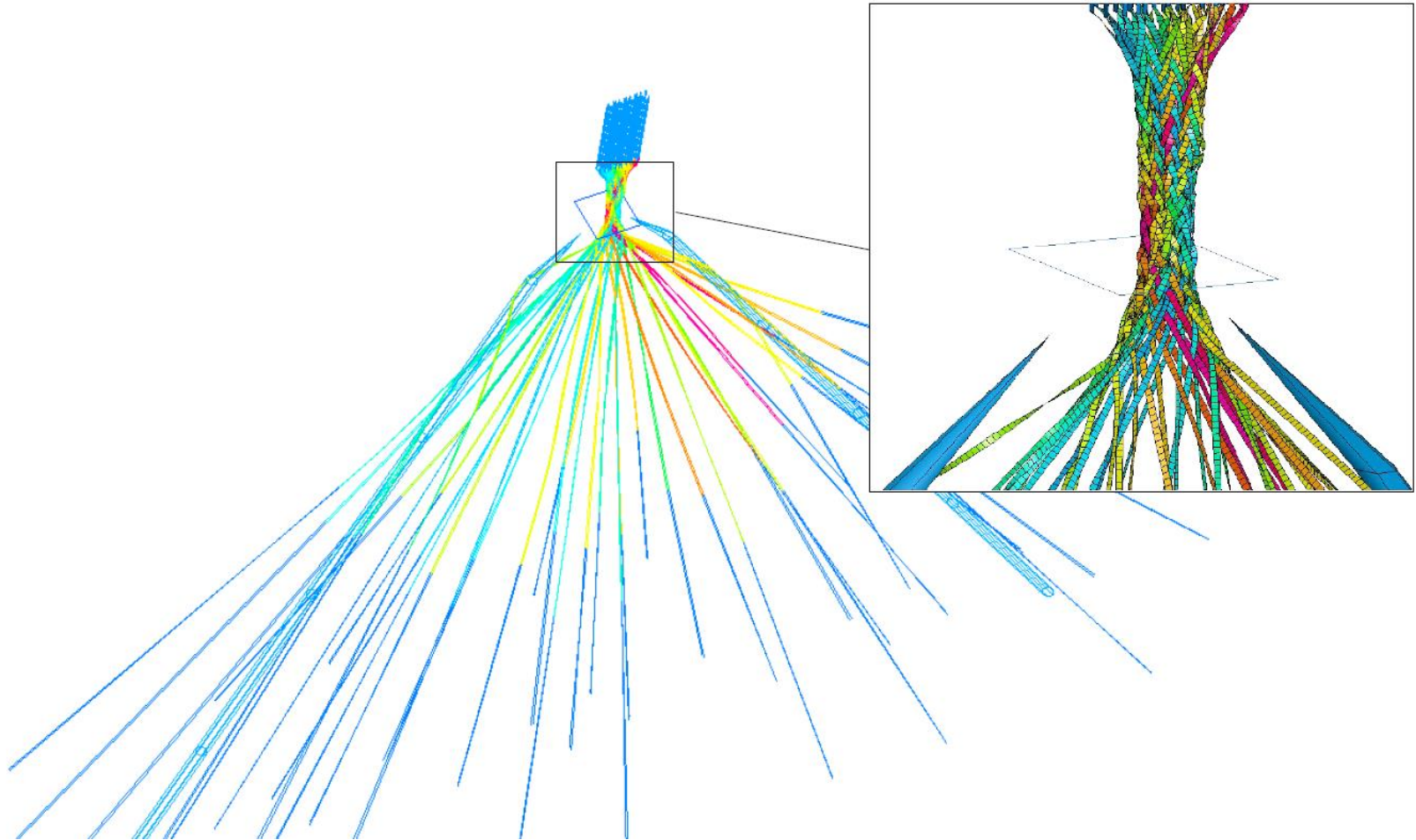
b

Zhou, E.; Sun, X.; Wang, Y. (2004): Multi-Chain digital element analysis in textile mechanics. In: *Composite Science and technology* 64 (2), S. 239–244.

Prozesssimulation

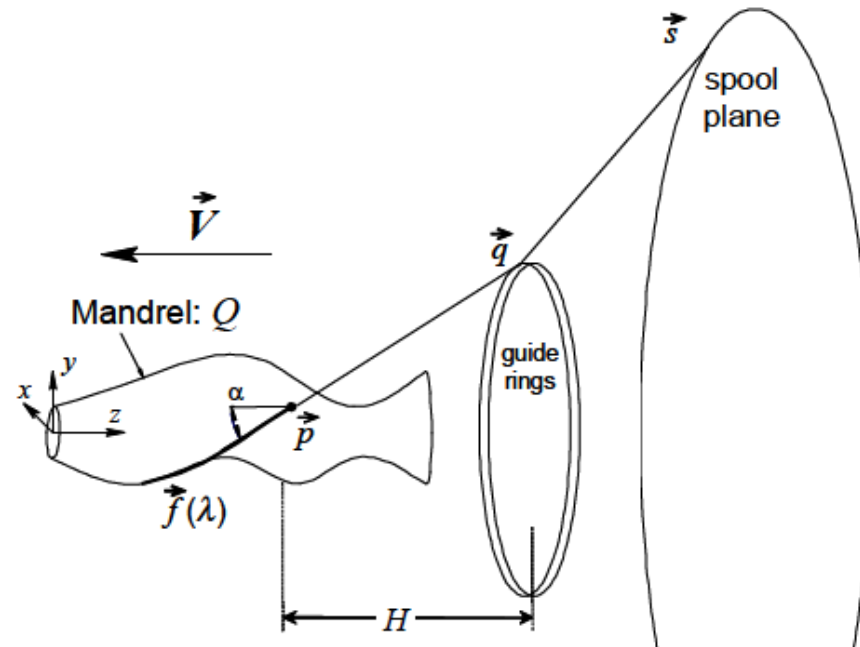
STAND DER TECHNIK

Explicit FEM for simulation



Pam Crash simulation of the braiding - Team of A. Picket - IFB Stuttgart, Germany

Process simulation, based on the process kinematics



BRAIDING SIMULATION FOR RTM PREFORMS $\vec{f}(\lambda)$ del of a braiding machine with a complex mandrel.

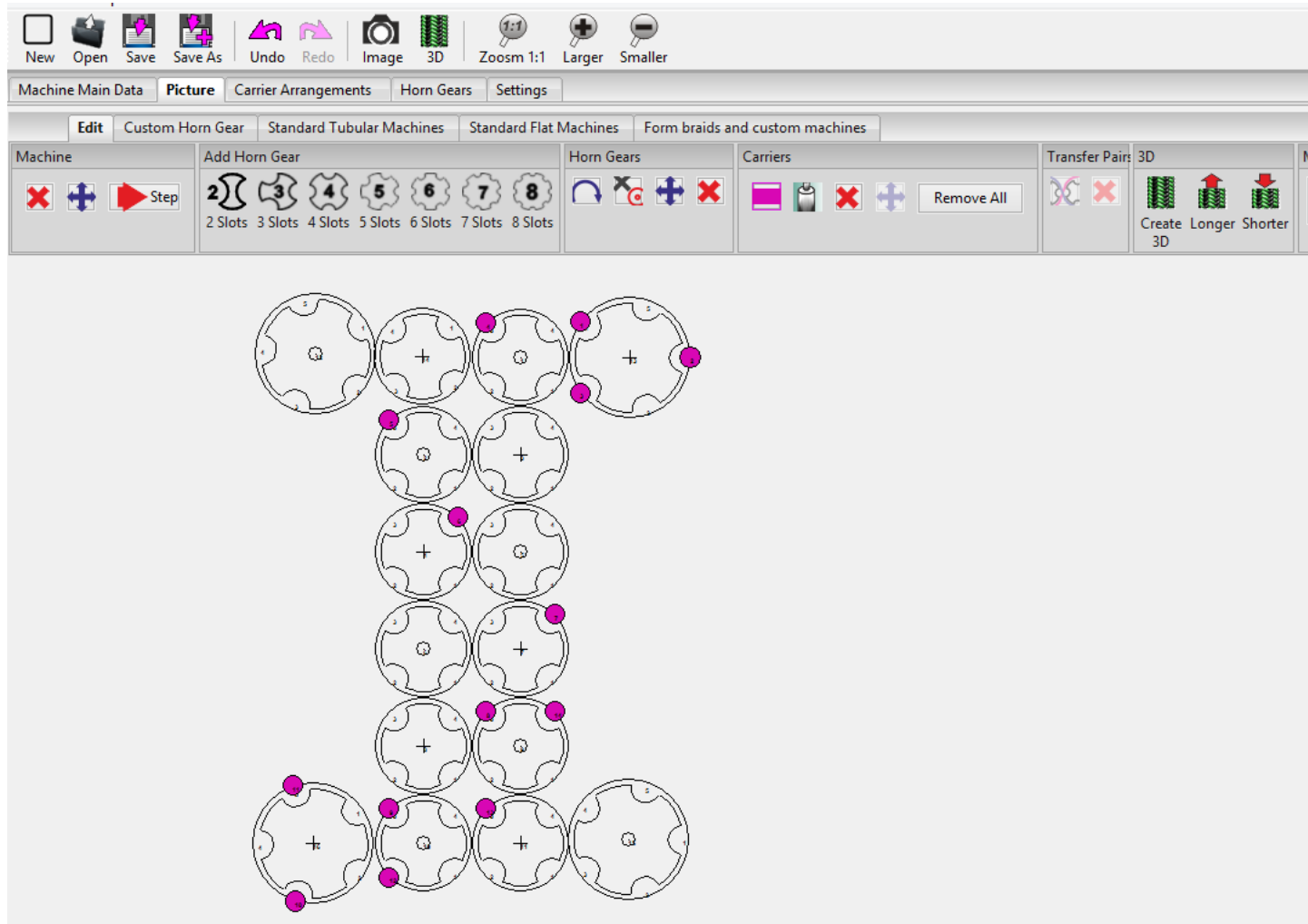
R. Akkerman & B.H. Villa Rodríguez
University of Twente
Faculty of Engineering Technology,
P.O. Box 217, 7500AE, Enschede, NL
r.akkerman@utwente.nl

$$\vec{f}(\gamma) = \vec{p}(t) + \gamma \cdot (\vec{q}(t) - \vec{p}(t)); \quad 0 \leq \gamma \leq 1,$$

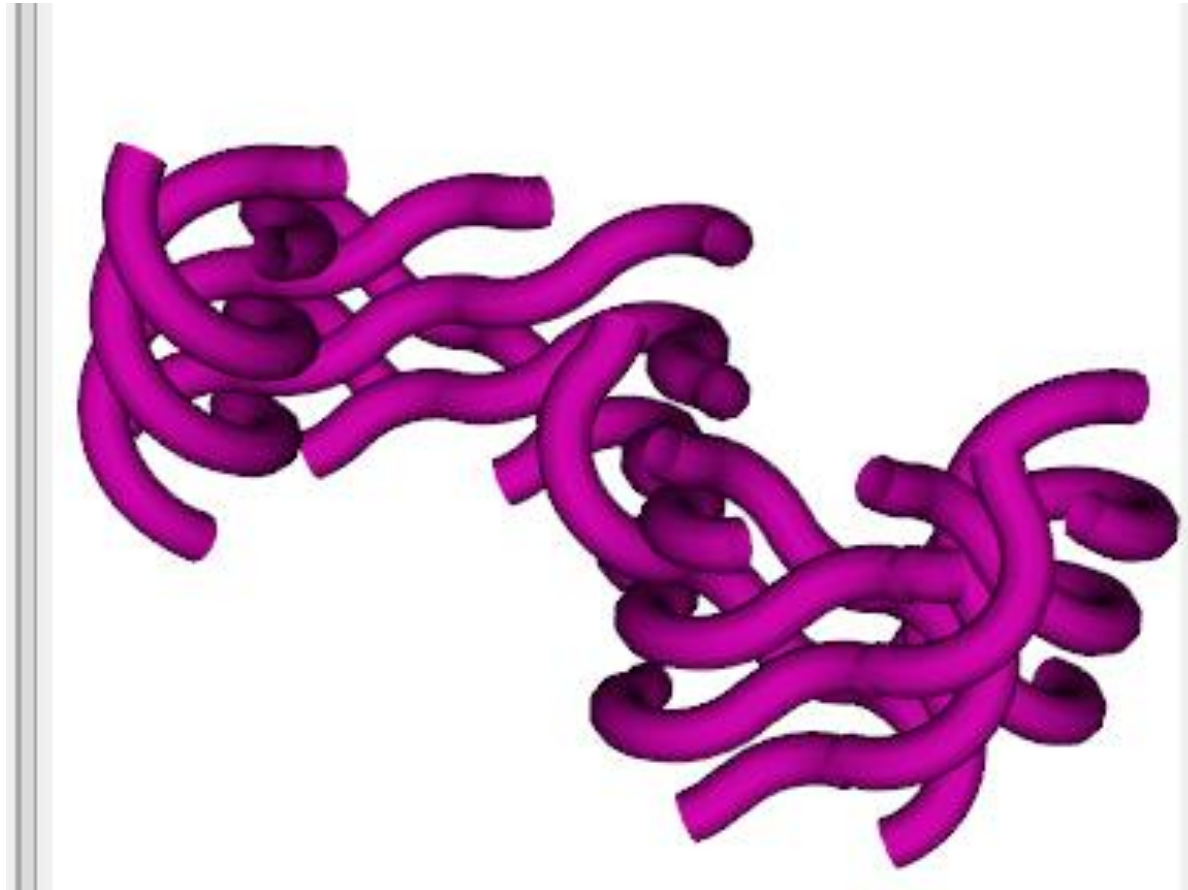
Prozesssimulation

FLECHTEMULATOR: „CONFIGURATOR“

Braiding machine configurator



www.texmind.com



Einladung

<http://www.hs-niederrhein.de/narrow-textiles/>

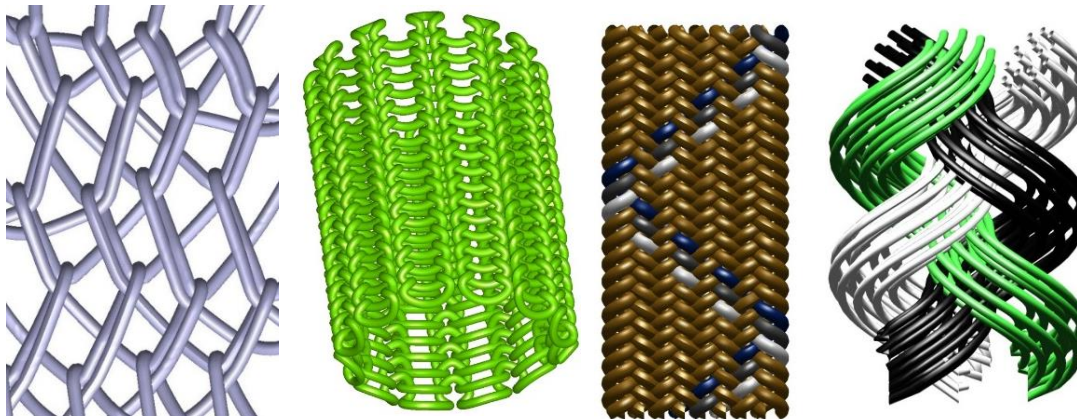
International Week of Narrow Textiles March 14 - 18, 2016

Narrow Fabrics Laboratory at the Faculty of Textile and Clothing Technology,
Hochschule Niederrhein – University of Applied Sciences, Mönchengladbach invites you
to **International Week of Narrow Textiles** (March 14 - 18, 2016).

Programme:

- 14. March 2016 Course: Carrier arrangement, structural and colour patterning of braids
- 15. March 2016 **2. Mönchengladbach Braiding Colloquium** - Programm (dt./eng.) **PDF** →
- 16. March 2016 Communication day / Excursion
- 17. March 2016 **1. Mönchengladbach Narrow Weaving Colloquium** - Programm
(dt./eng.) **PDF** →
- 18. March 2016 Course: Patterning of multilayer tapes with one and two weft inserting
elements

Danke für Ihre Aufmerksamkeit



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www.hs-niederrhein.de