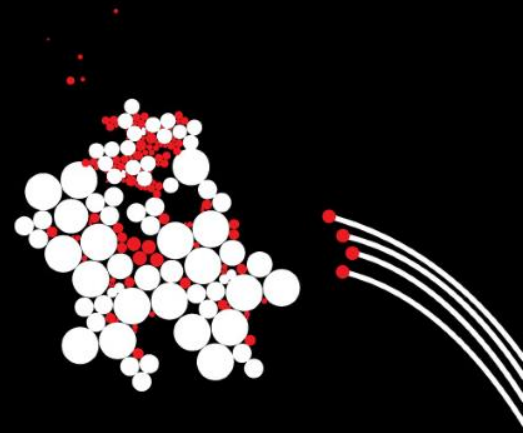


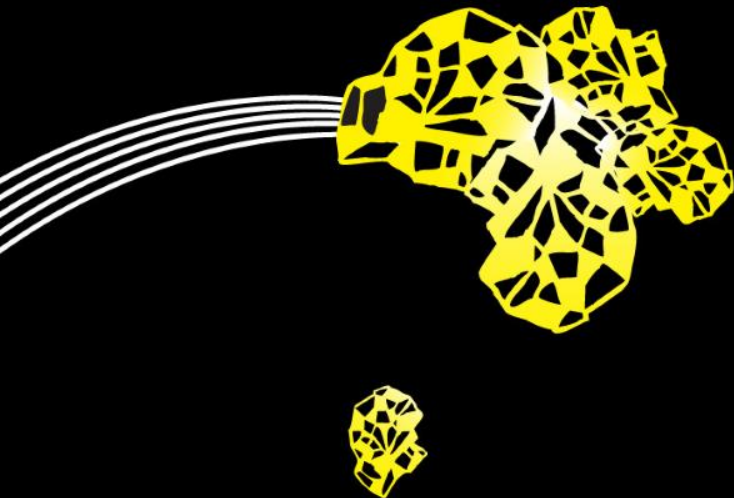


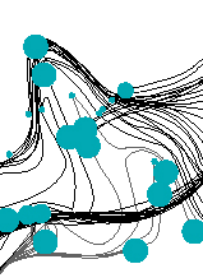
Simulation of the overbraiding process using complex shaped mandrels

Flecht-Kolloquium 2014, Friday November 7, 2014

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Faculty of Engineering Technology, Chair of Production Technology





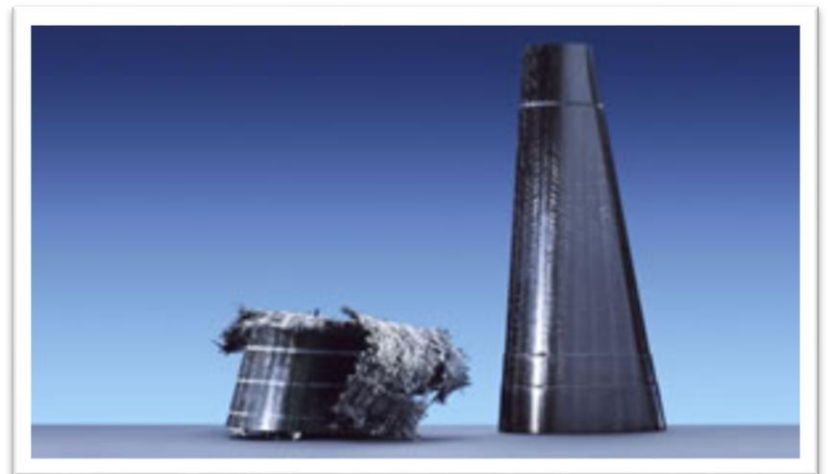
Contents

- 
- An abstract black line drawing on the left side of the slide, resembling a stylized, elongated shape with a jagged, irregular outline.
- Introduction
 - Problem
 - **Analysis - neglecting yarn interaction**
 - **Experiment**
 - **Analysis - including yarn interaction**
 - Conclusions & Recommendations



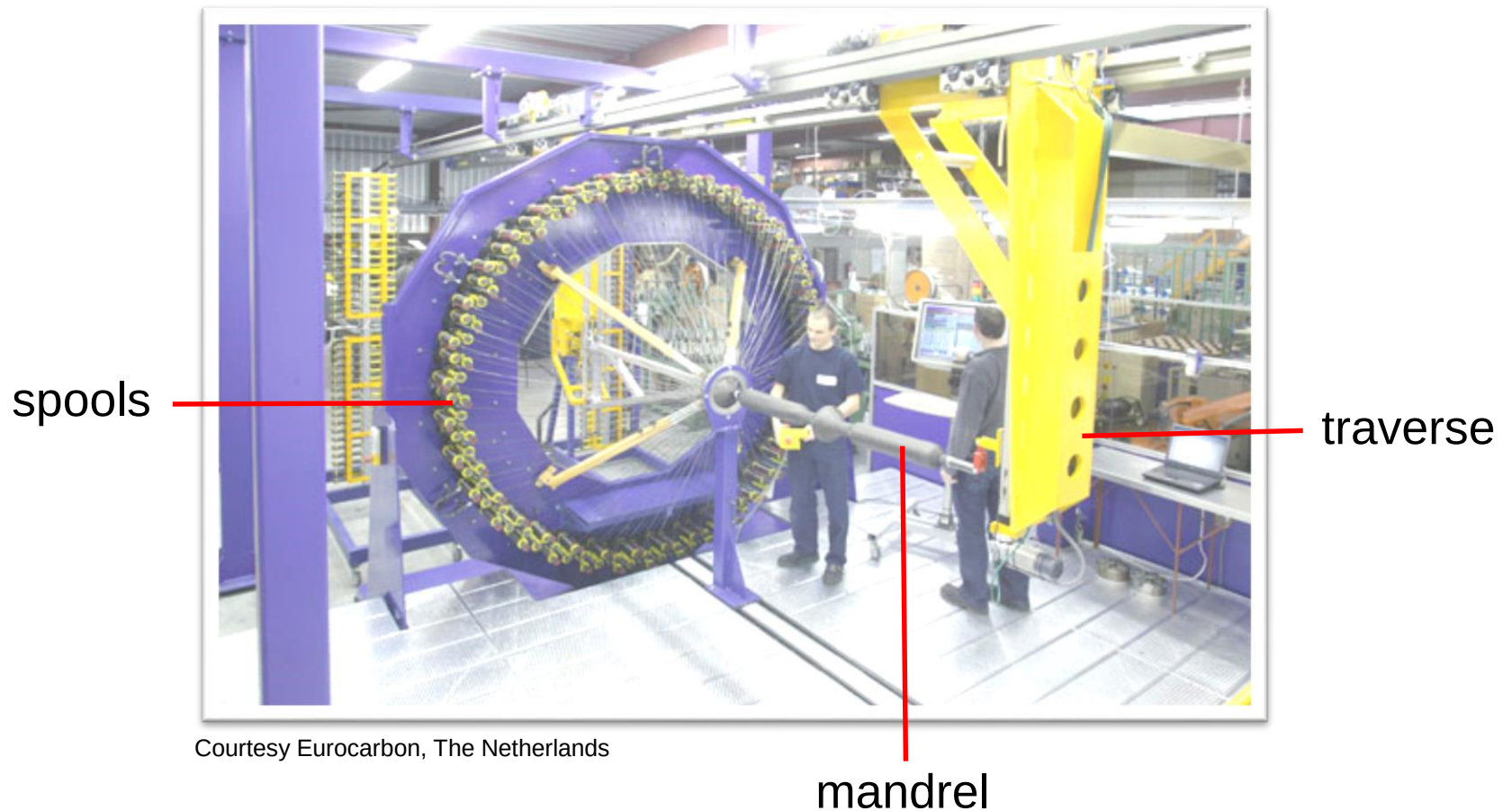
Introduction - braiding

Braiding examples



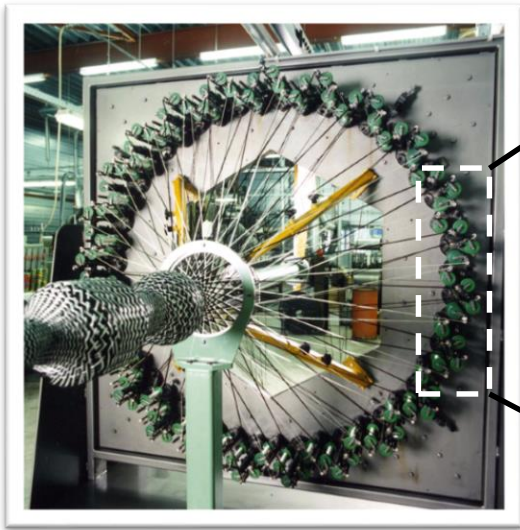
Introduction

Circular braiding

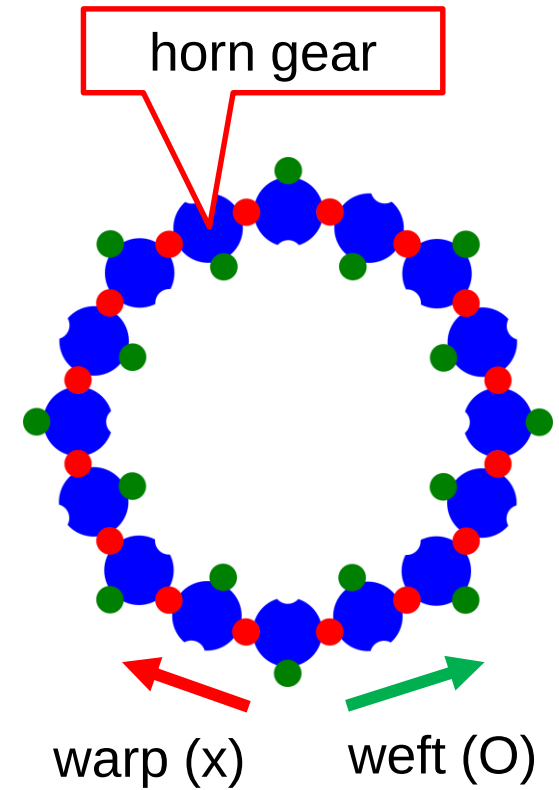
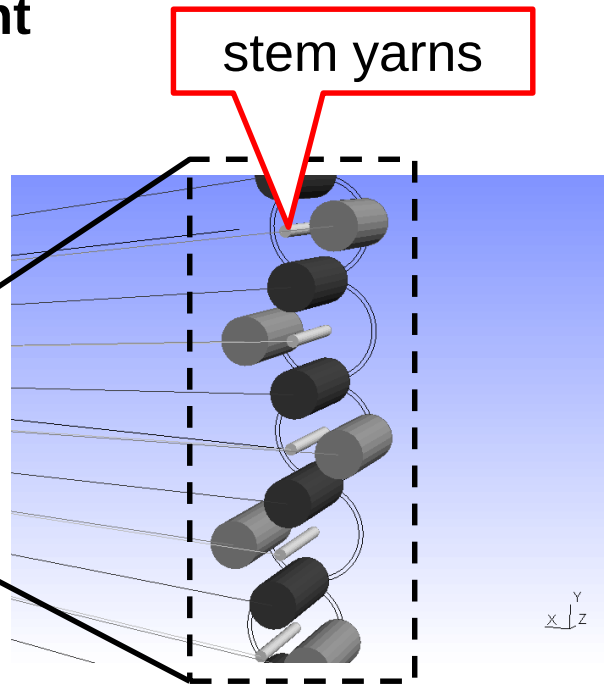


Introduction

Spool movement



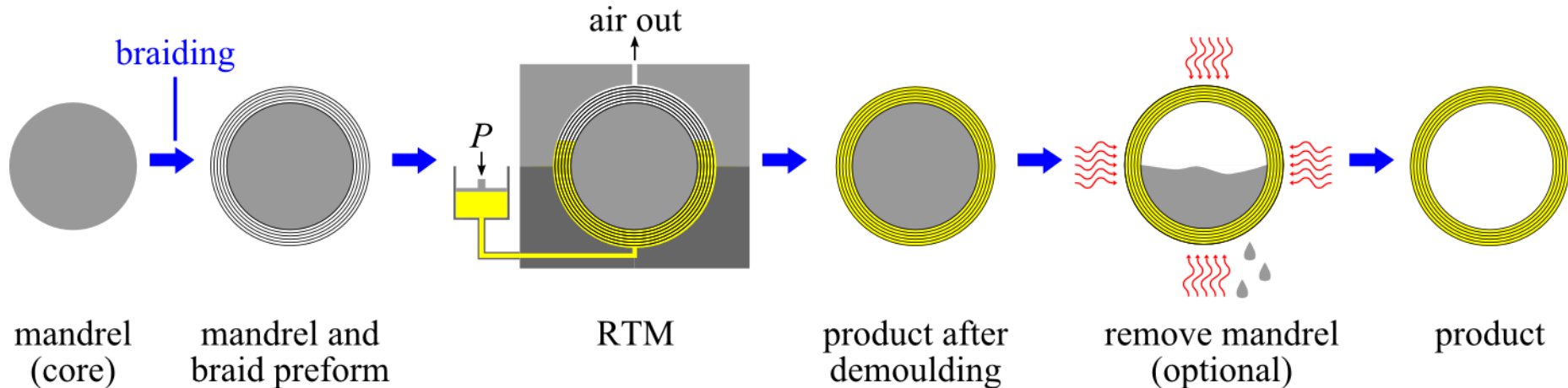
Courtesy Eurocarbon, The Netherlands



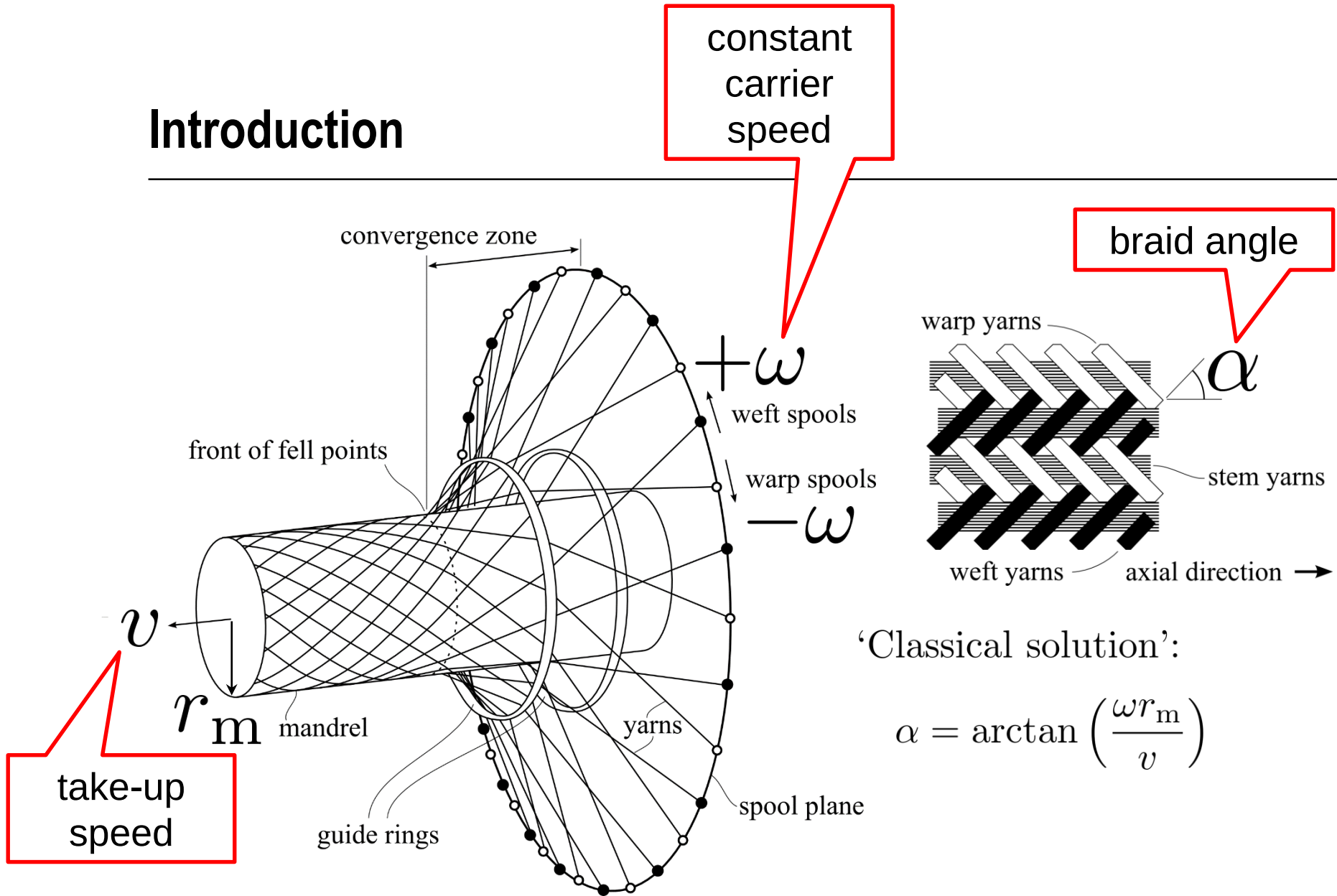
Introduction

Process chain

- used for production of braided composite preforms,
- preforms are used for e.g. RTM (Resin Transfer Moulding) process,
- fiber material: dry or commingled thermoplastic



Introduction

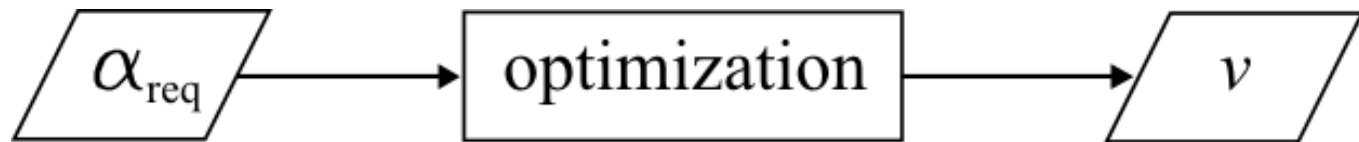


Problem

Given:

- mandrel geometry,
- laminate plan with required α ,
- machine with constant carrier speed ω :

How to **automatically** generate
the take-up speed **profile**
for an **arbitrary** mandrel?

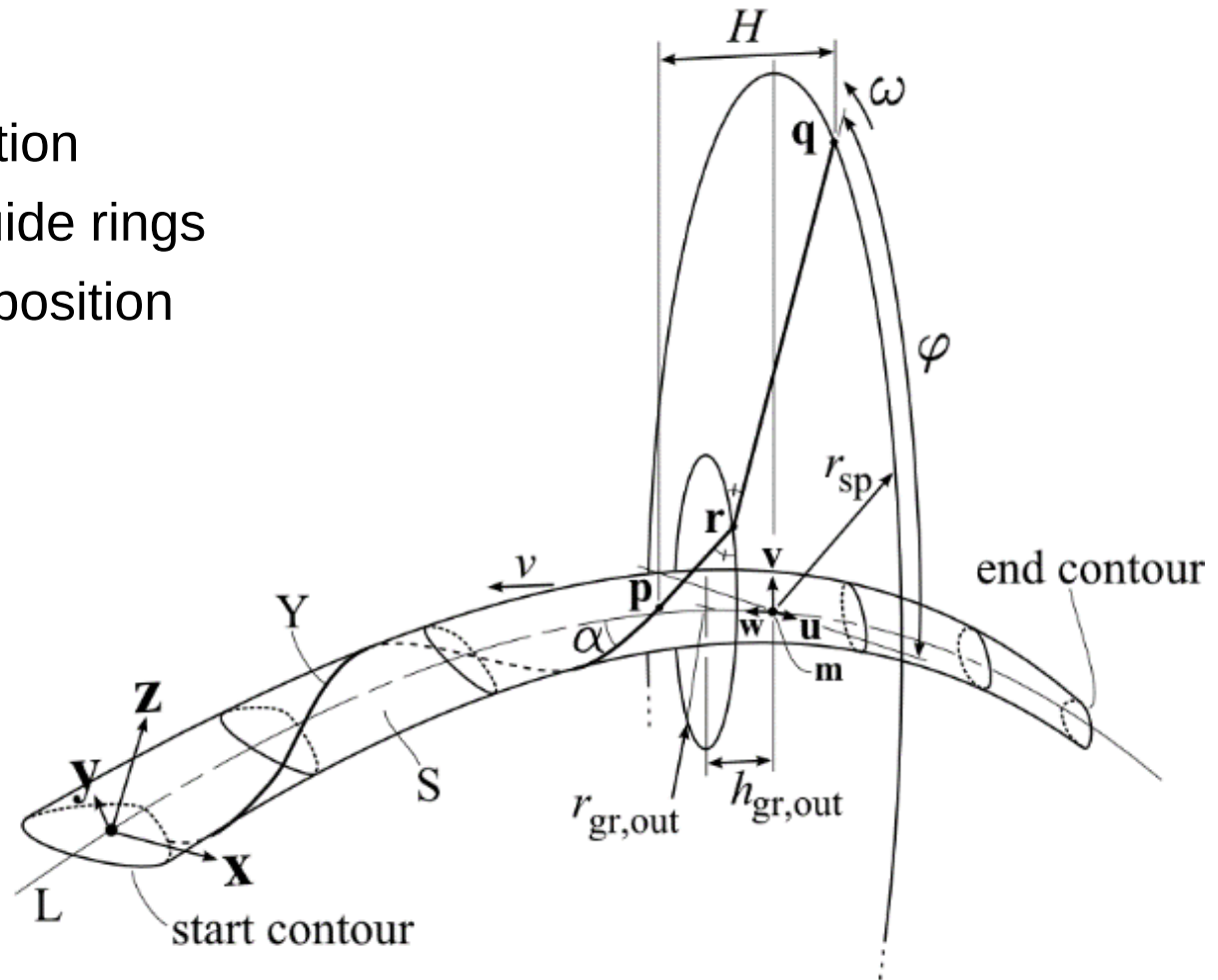


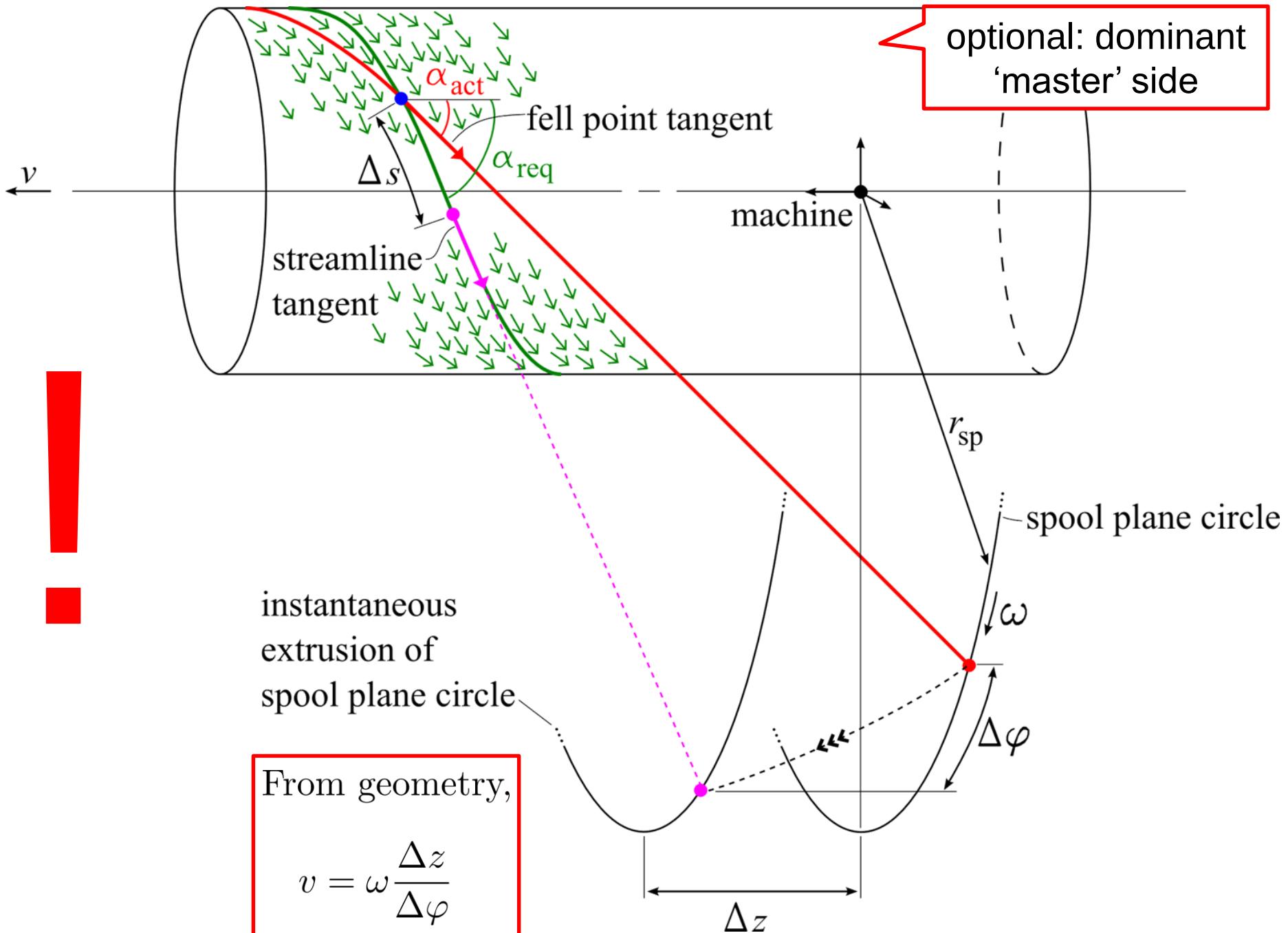
...by inverse kinematics

Analysis - neglecting yarn interaction

Assumptions:

- no yarn interaction
- no friction at guide rings
- no slip after deposition





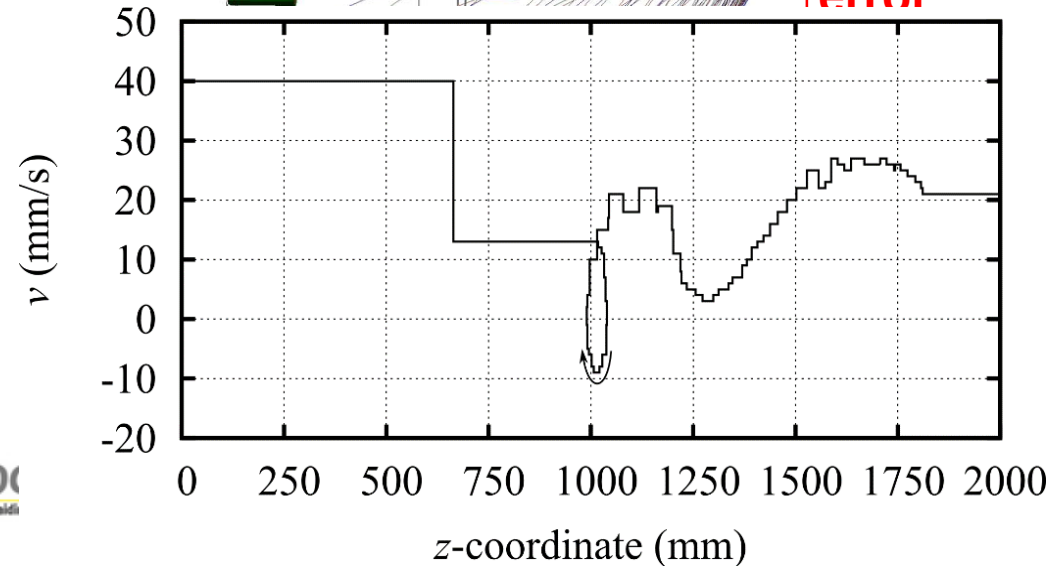
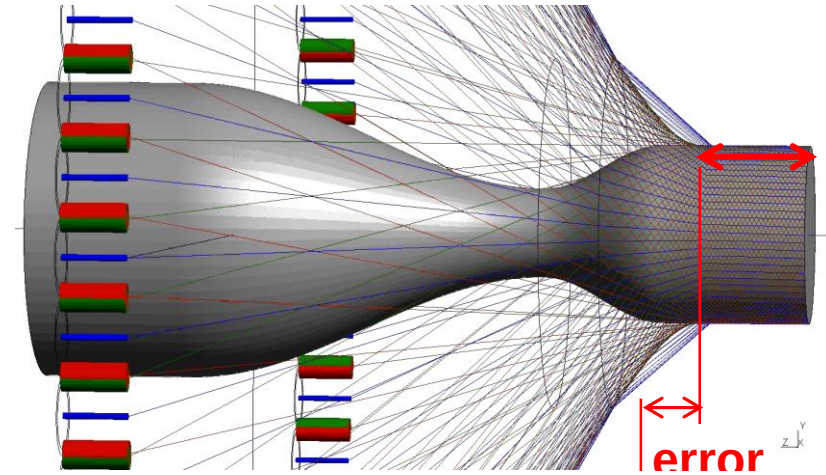
Experiment

Mismatch:

- model VS experiment
- Braid angle: 15° error



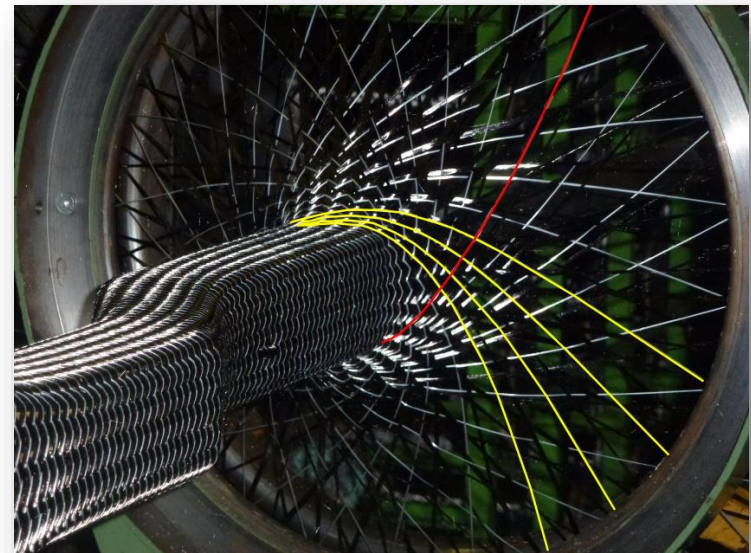
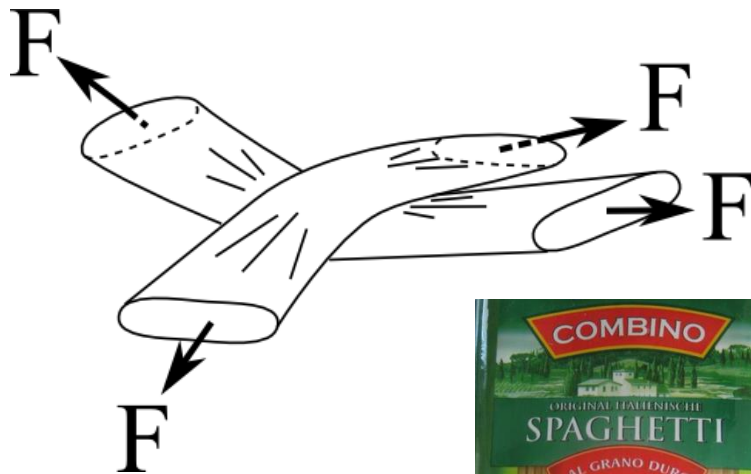
BRAIDSim
VIRTUAL BRAIDING



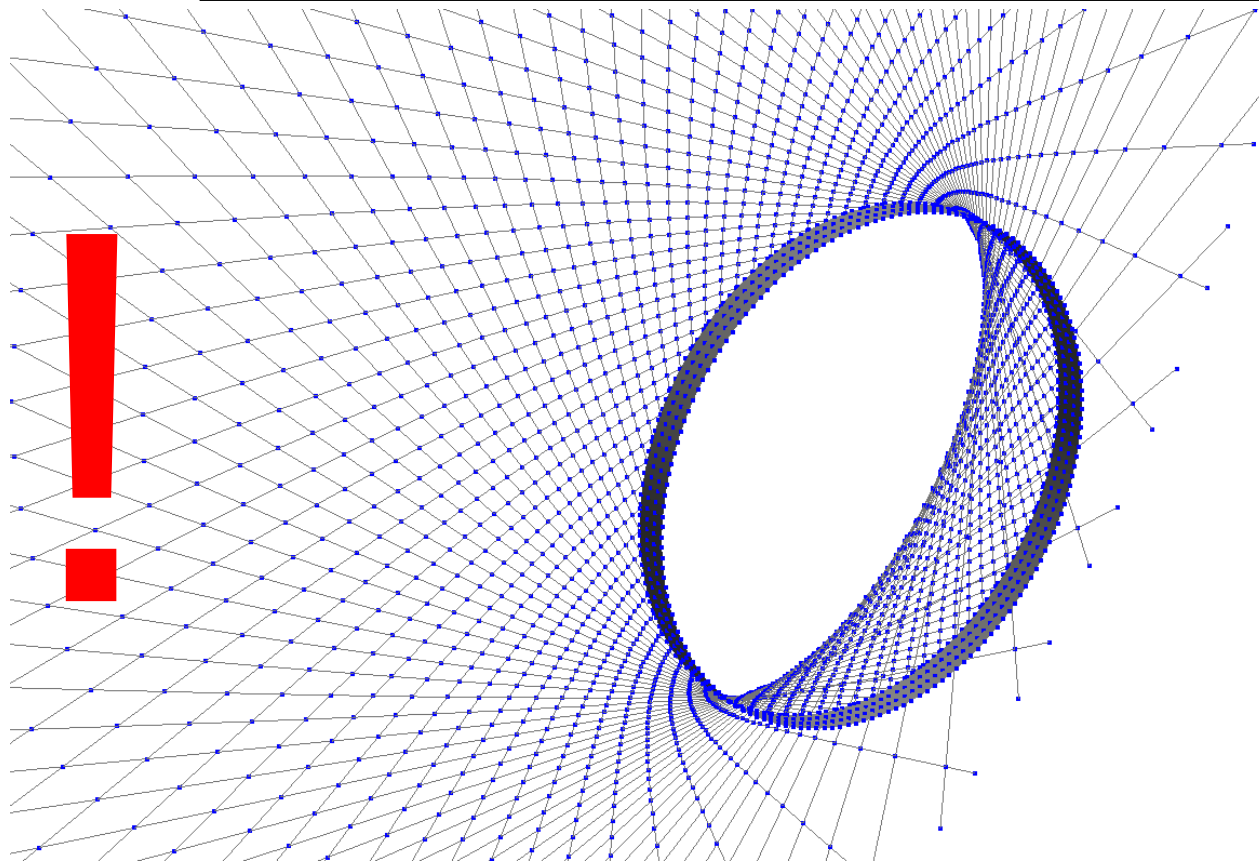
Analysis - including yarn interaction

Presumed main cause:

- “Neglect of yarn interaction”

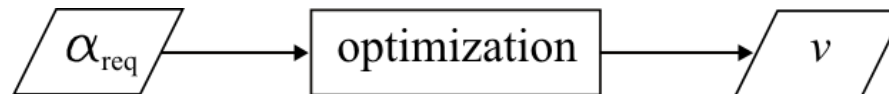


Analysis - including yarn interaction



Assumptions:

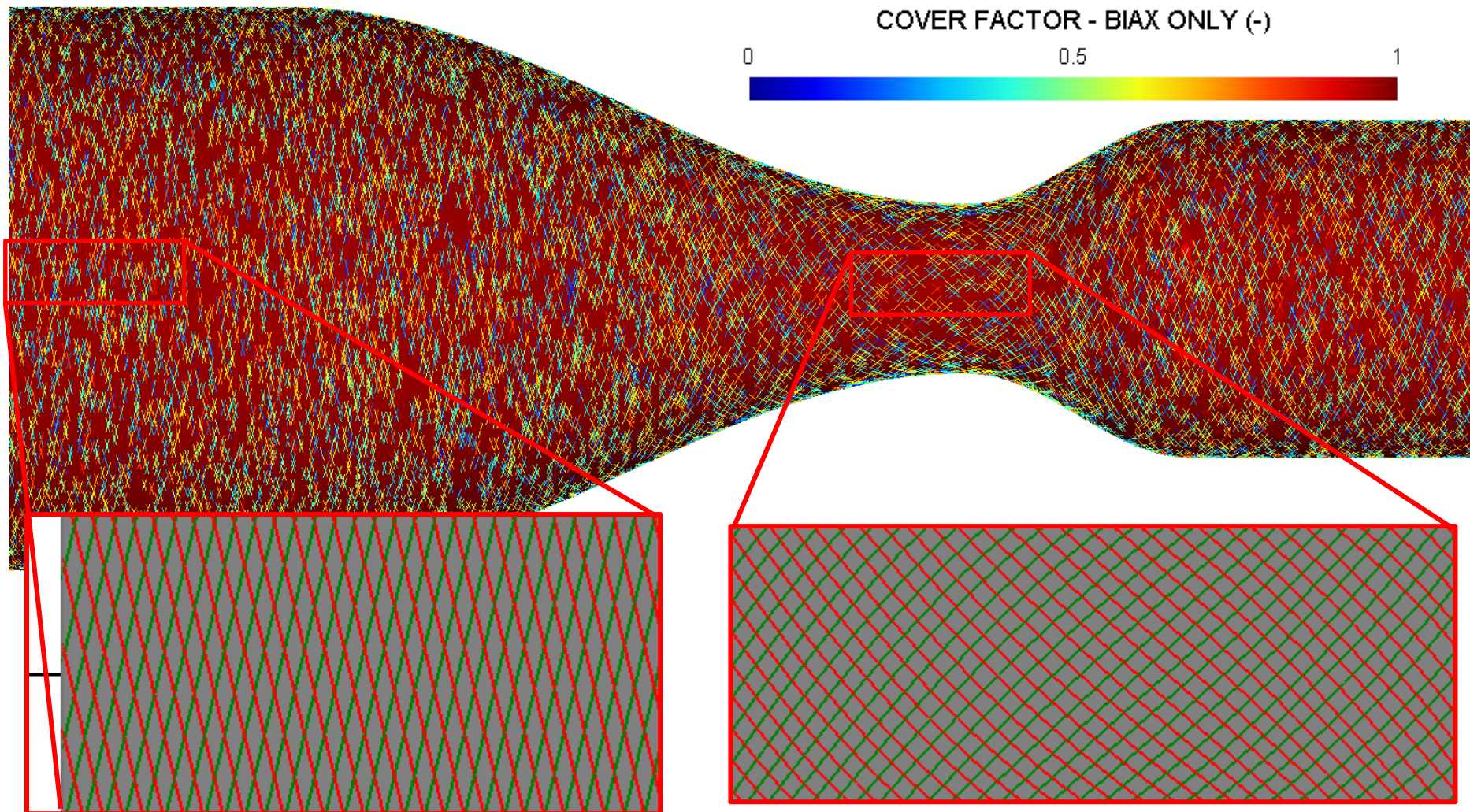
- biaxial braid
- axisymmetry
- steady state



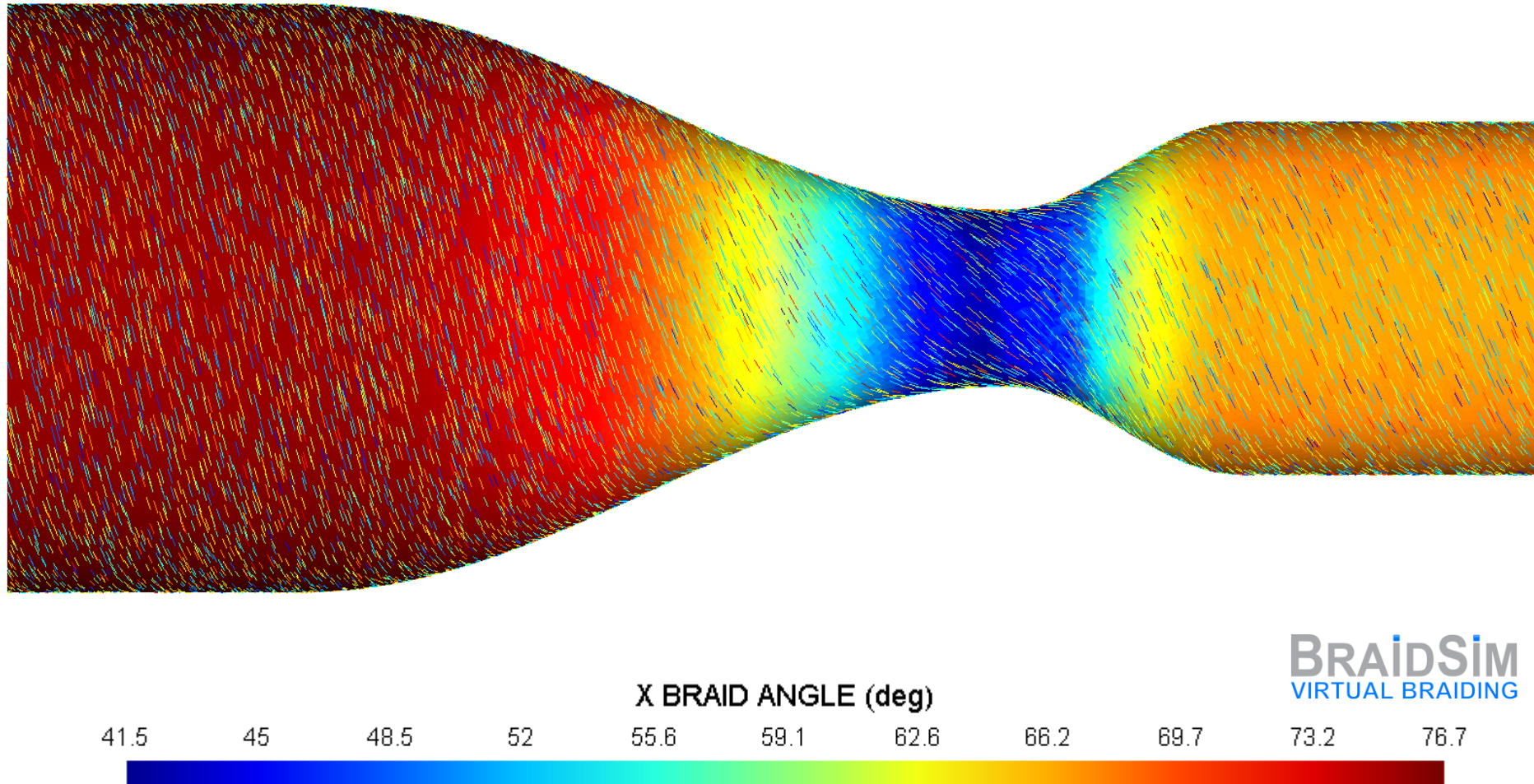
...by inverse kinematics



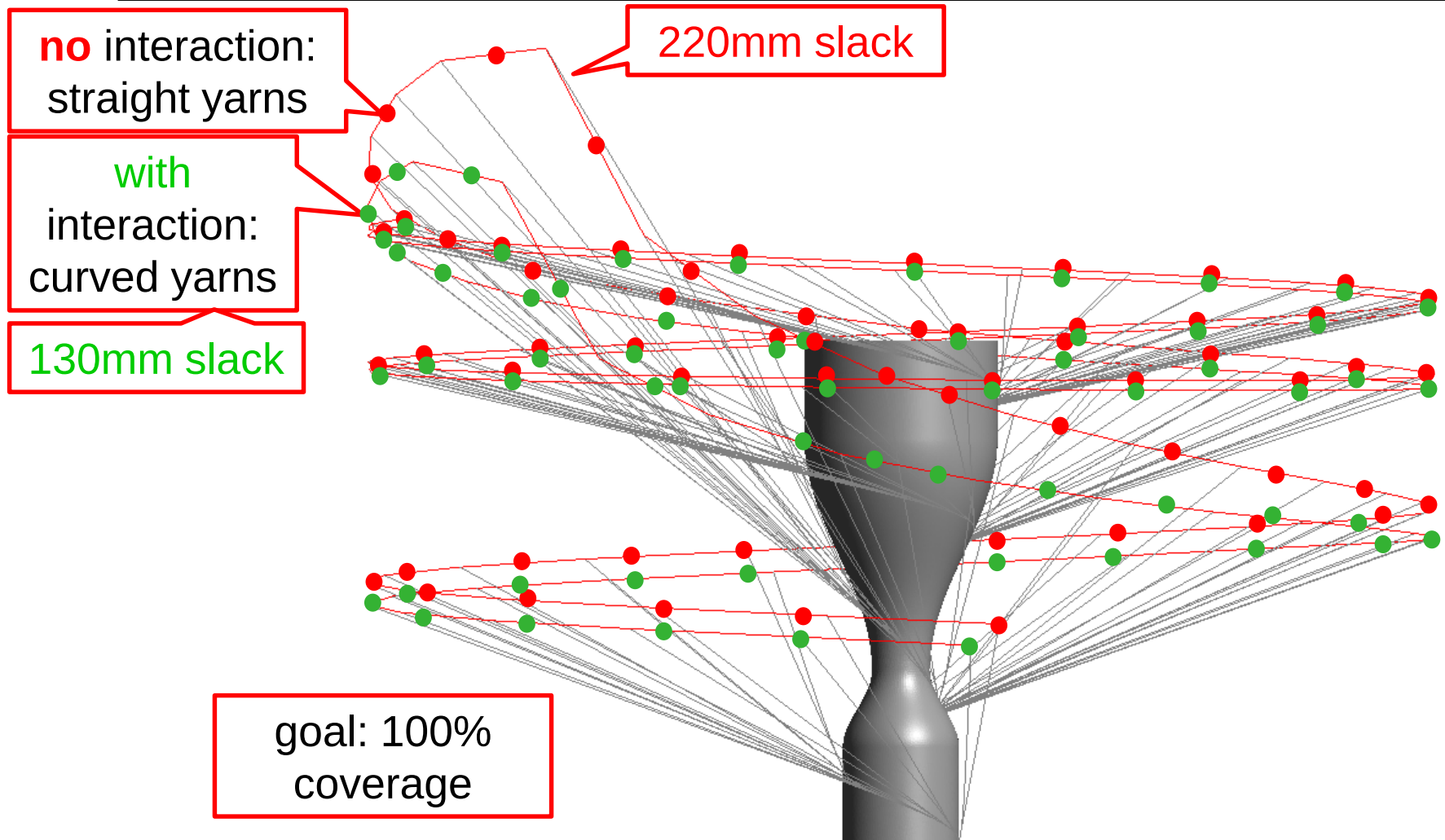
Analysis - including yarn interaction



Analysis - including yarn interaction



Analysis result - including yarn interaction



Conclusions

- Significant braid angle error when neglecting yarn interaction.
- Including yarn interaction leads to a significant change in:
 - take-up speed profile,
 - predicted amount of yarn slack.
- Appropriate machine control required

Recommendations

- Validate axisymmetric yarn interaction model by experiment.
- Design and implement a yarn interaction model for forward solution (input: speeds, output: braid angle) for arbitrary shapes.
 - Coulomb / Howell friction
- validate for arbitrary shapes.

Acknowledgements

