

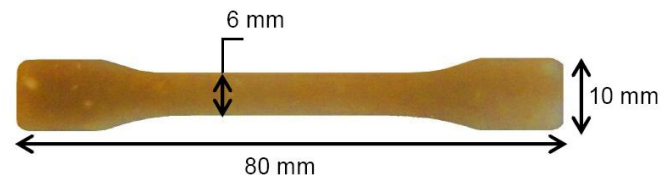
# SWELLING OF CELLULOSE FIBRES IN COMPOSITE MATERIALS: CONSTRAINT EFFECTS OF SURROUNDING MATRIX

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# MOTIVATION

- Disadvantage of cellulose based materials:



- Composite: possibility to control swelling by microstructural design

# INTRODUCTION

- Hydrophilic wood fibres (softwood)
- Relatively hydrophobic matrix (PLA)



- Hygroexpansion of fibres (softwood): 0.1 – 0.5
- Hygroexpansion of matrix (PLA):  $10^{-4}$

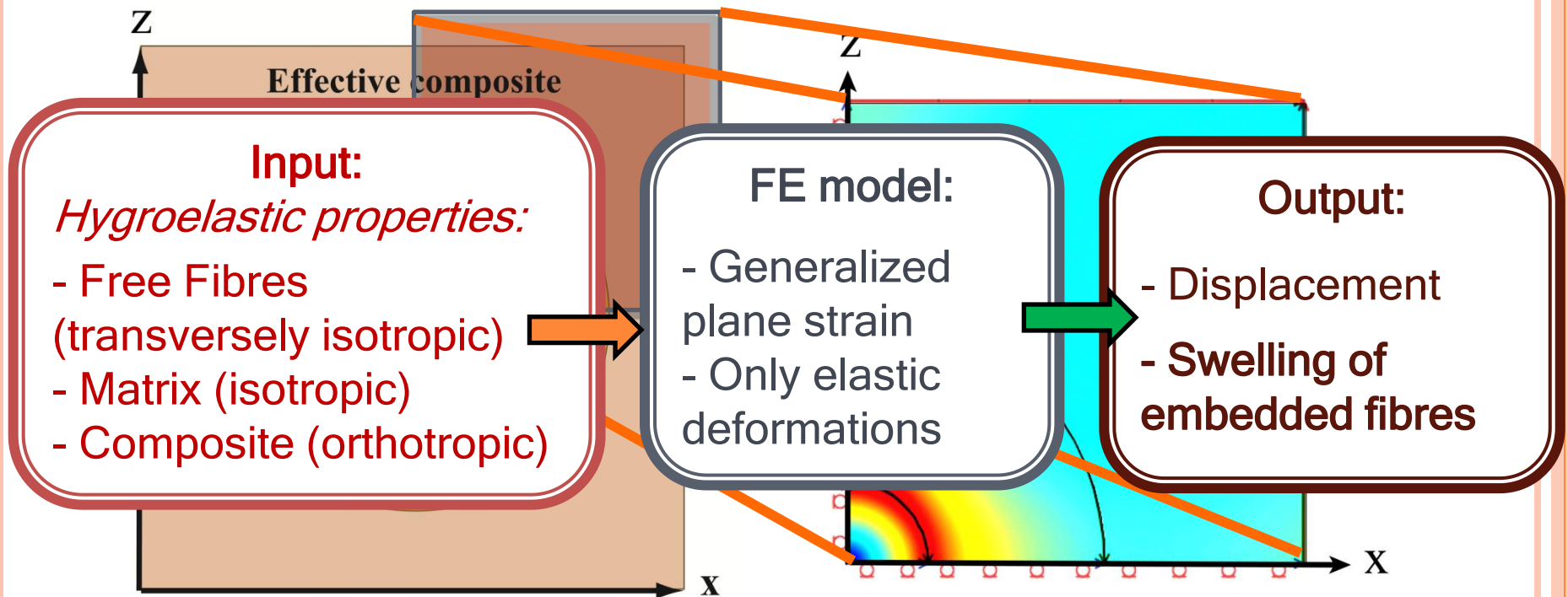


Constraint effect ( )



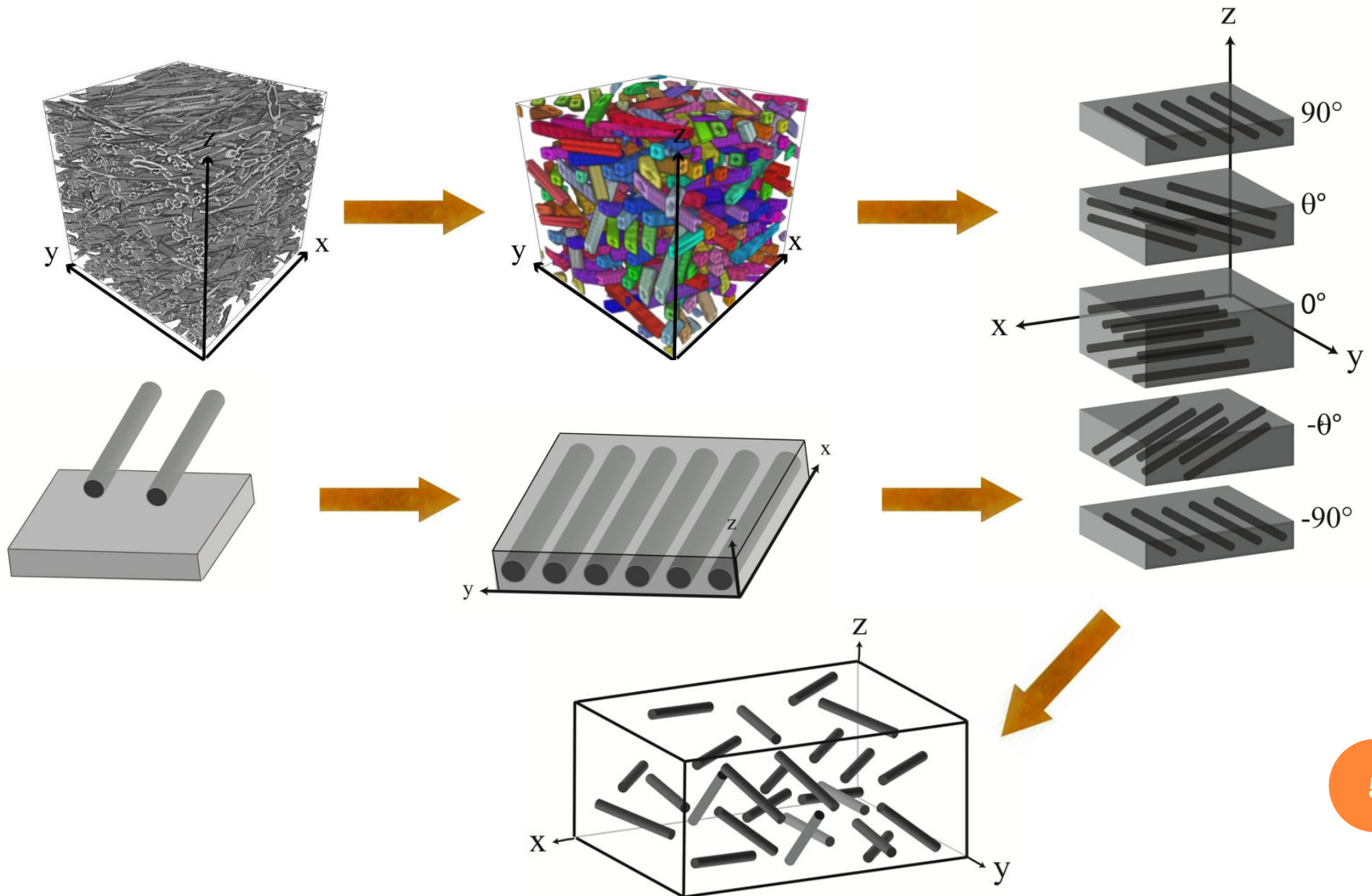
# MODELLING

## ○ Swelling of embedded fibres



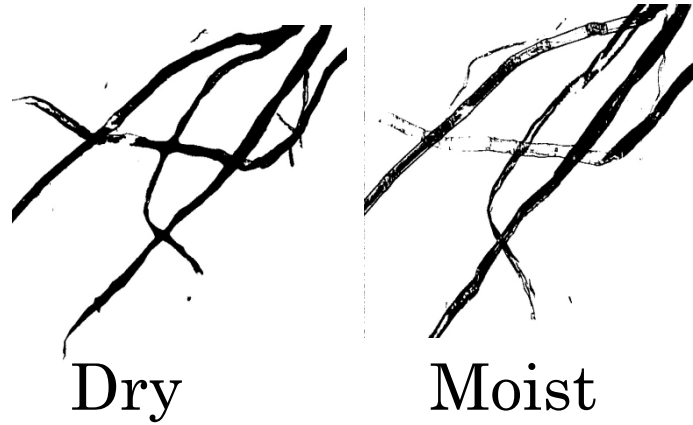
*Hashin's GSCS and displacement with FE simulation*

# ELASTIC PROPERTIES

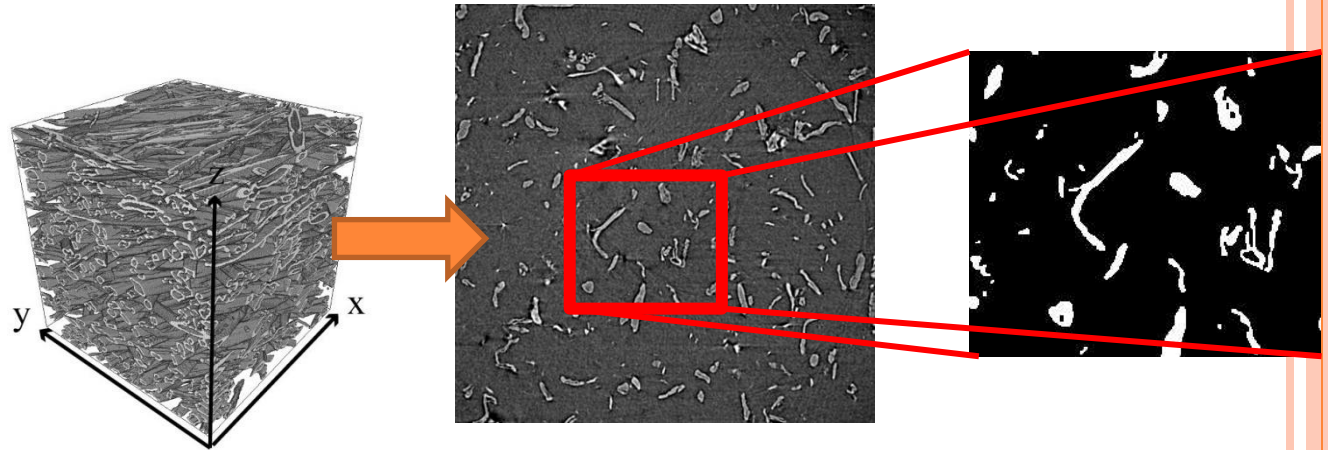


# SWELLING

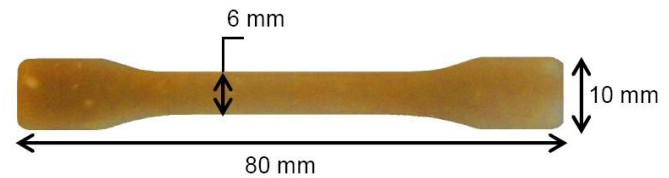
- Free fibres



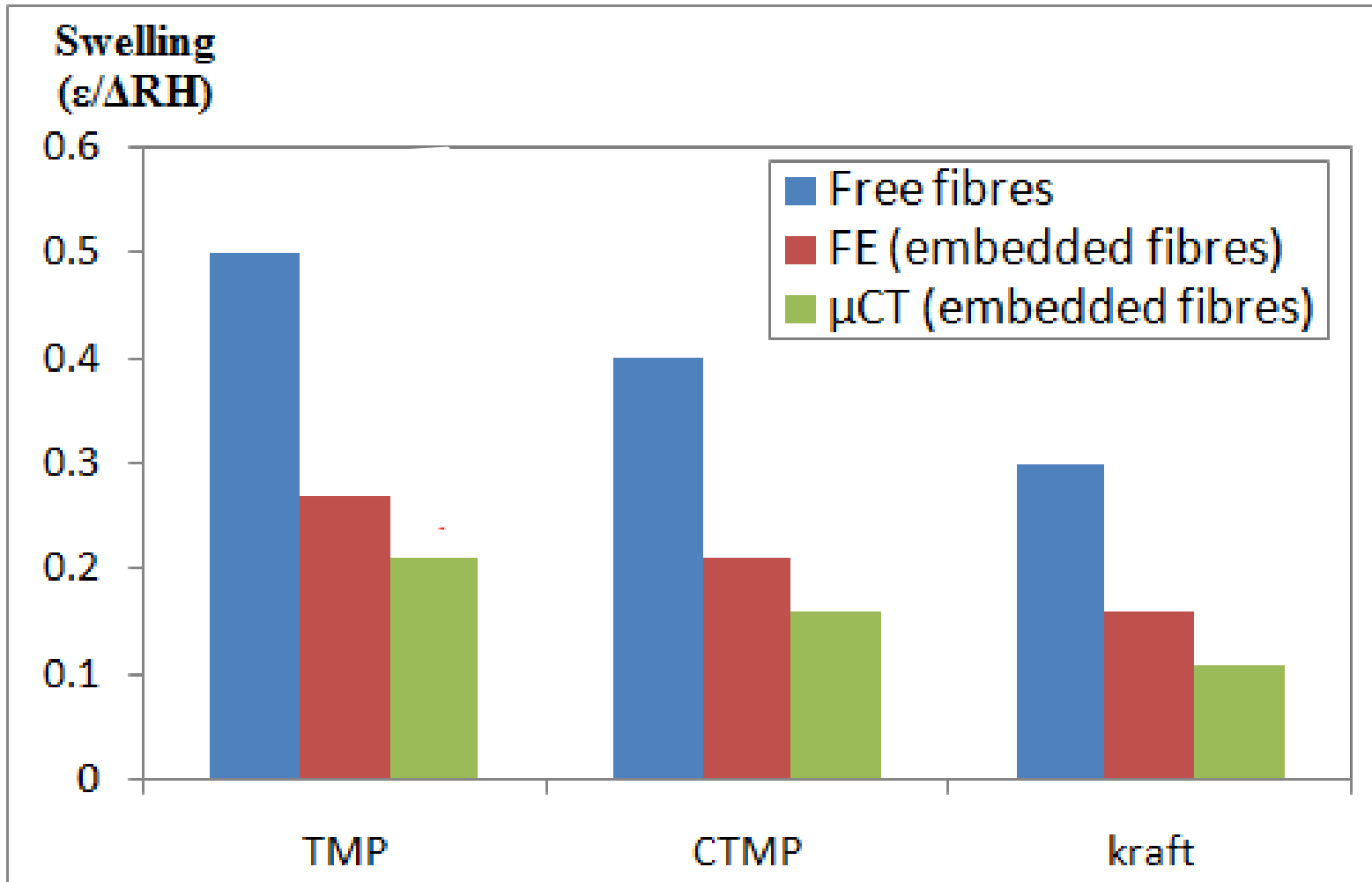
- Embedded fibres



- Composite



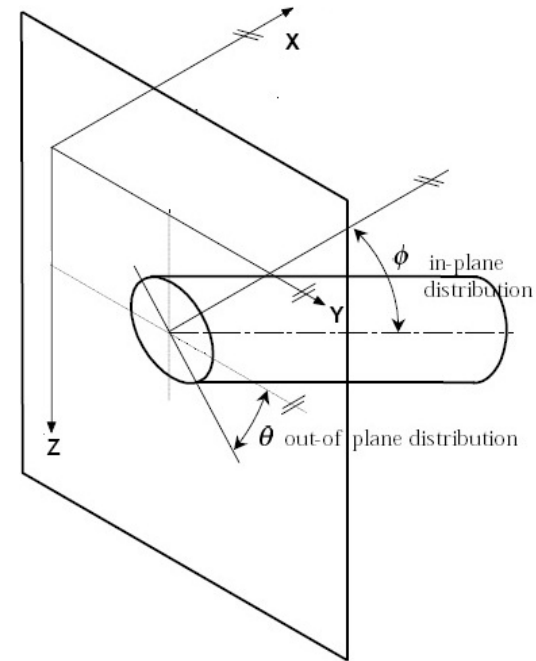
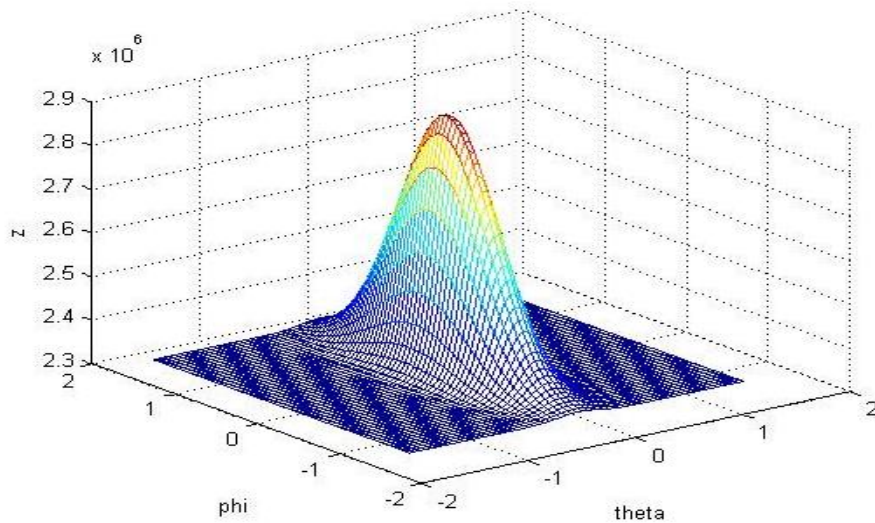
# RESULTS



- Thank you for your time and attention
- Do you have any question?

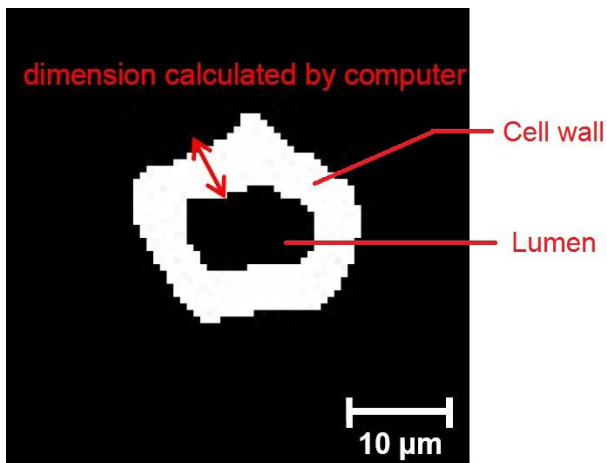
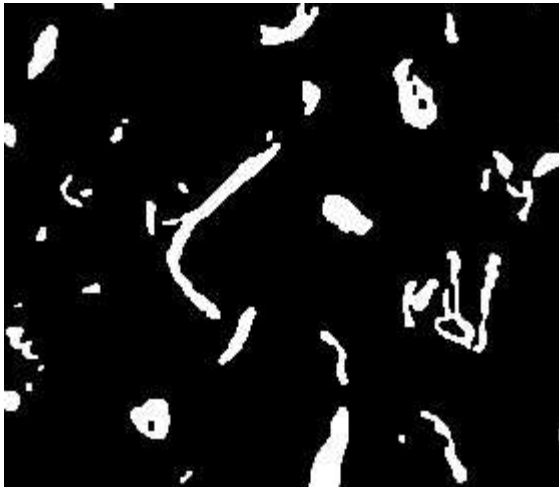


# FIBRE ORIENTATION DISTRIBUTION



$$\rho(\theta) = a + b \exp \left( -\frac{1}{2} \left( \frac{\theta - \mu}{\sigma} \right)^2 \right)$$

# VALIDATION



Underestimation of the swelling