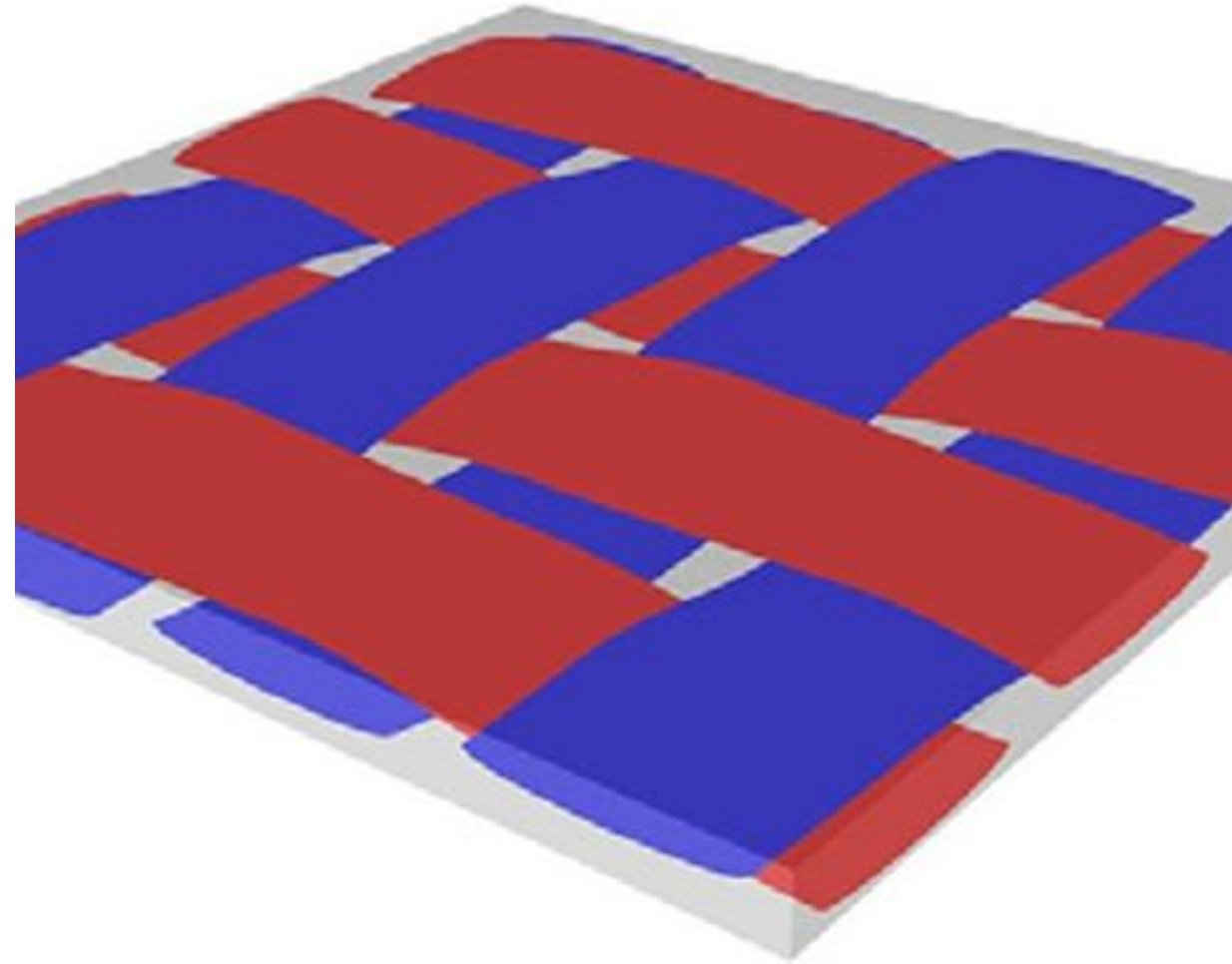


Prediction of Thermal Conductivity of 2D woven composites using Mechanics of Structure Genome (MSG) and Artificial Neural Network (ANN)

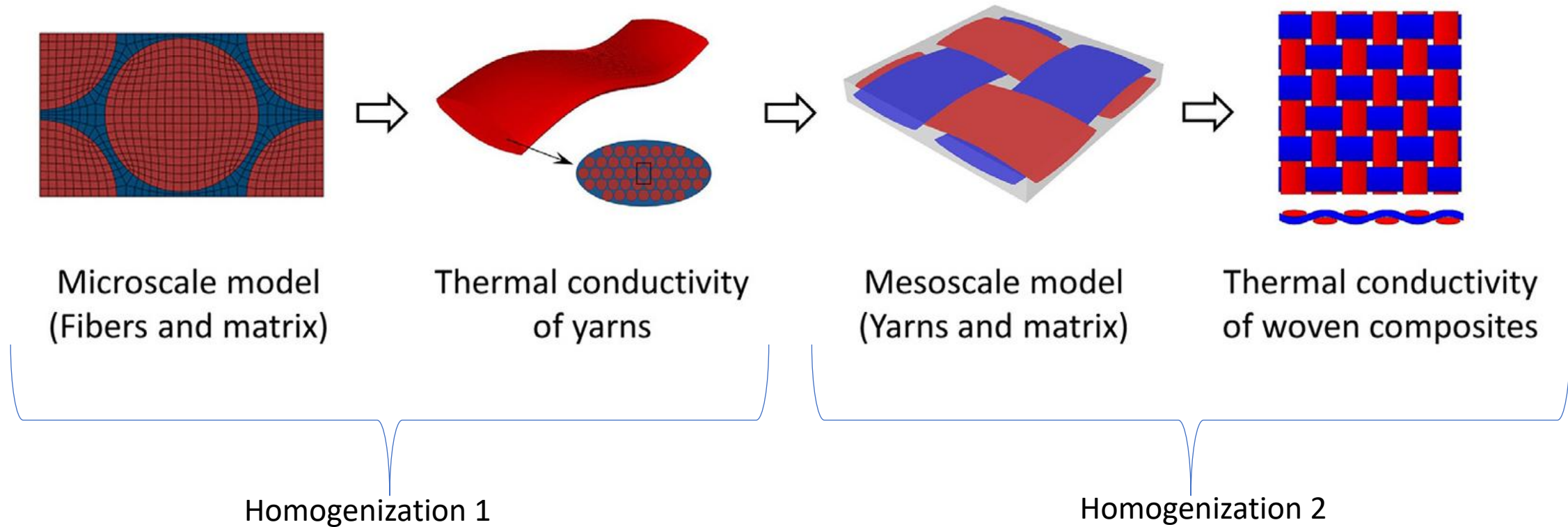
What are Woven composites and why use them ?

- Woven composites are a type of fiber-reinforced composite material where the reinforcing fibers are woven together in a fabric-like structure before being embedded in a matrix (usually a polymer resin like epoxy)
- Woven composites are extensively utilized in various structures—including fuselage frames, electronic devices, and medical implants—due to their outstanding **mechanical properties** and **cost-effective manufacturing**.
- The tailorable weave patterns associated with woven composites provide great design **freedom to enhance the mechanical & thermal performance of woven composite structures**.



Two Step Homogenization process

- The Multiscale modelling is done with a 2-step homogenization process

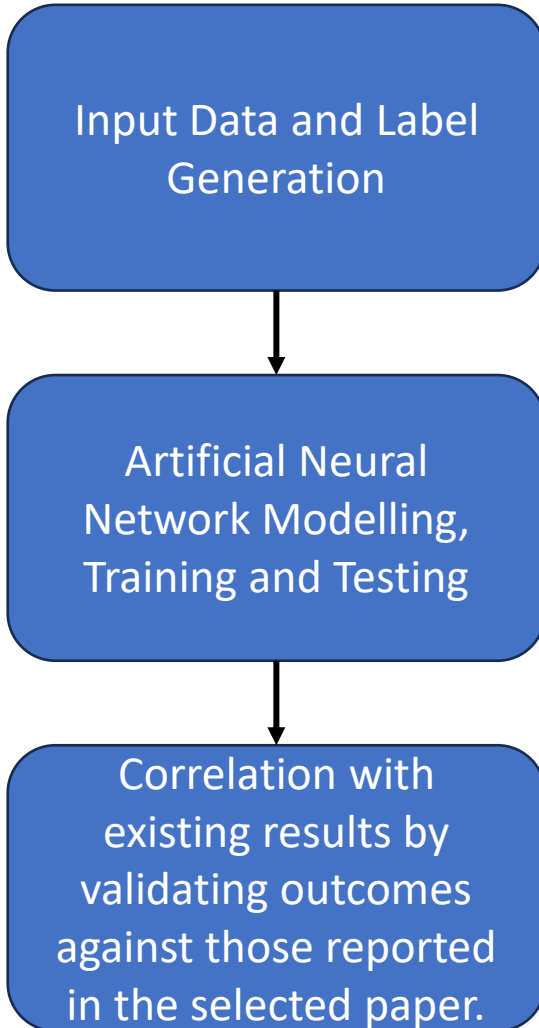


Thermal parameters of constituents at room temperature (25 °C) [26].

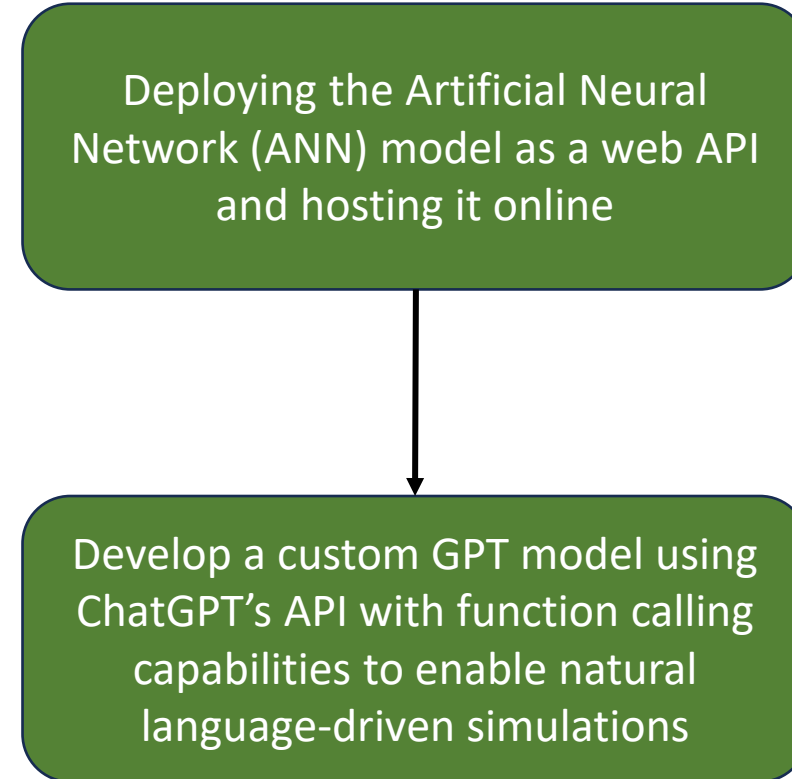
Thermal conductivity ($\text{W m}^{-1} \text{K}^{-1}$)	Carbon fiber T700S-12K	Epoxy resin JC-02A
Fiber direction	10.200	0.180
Transverse direction	1.256	0.180

Project Workflow

Re-implementation of code from paper

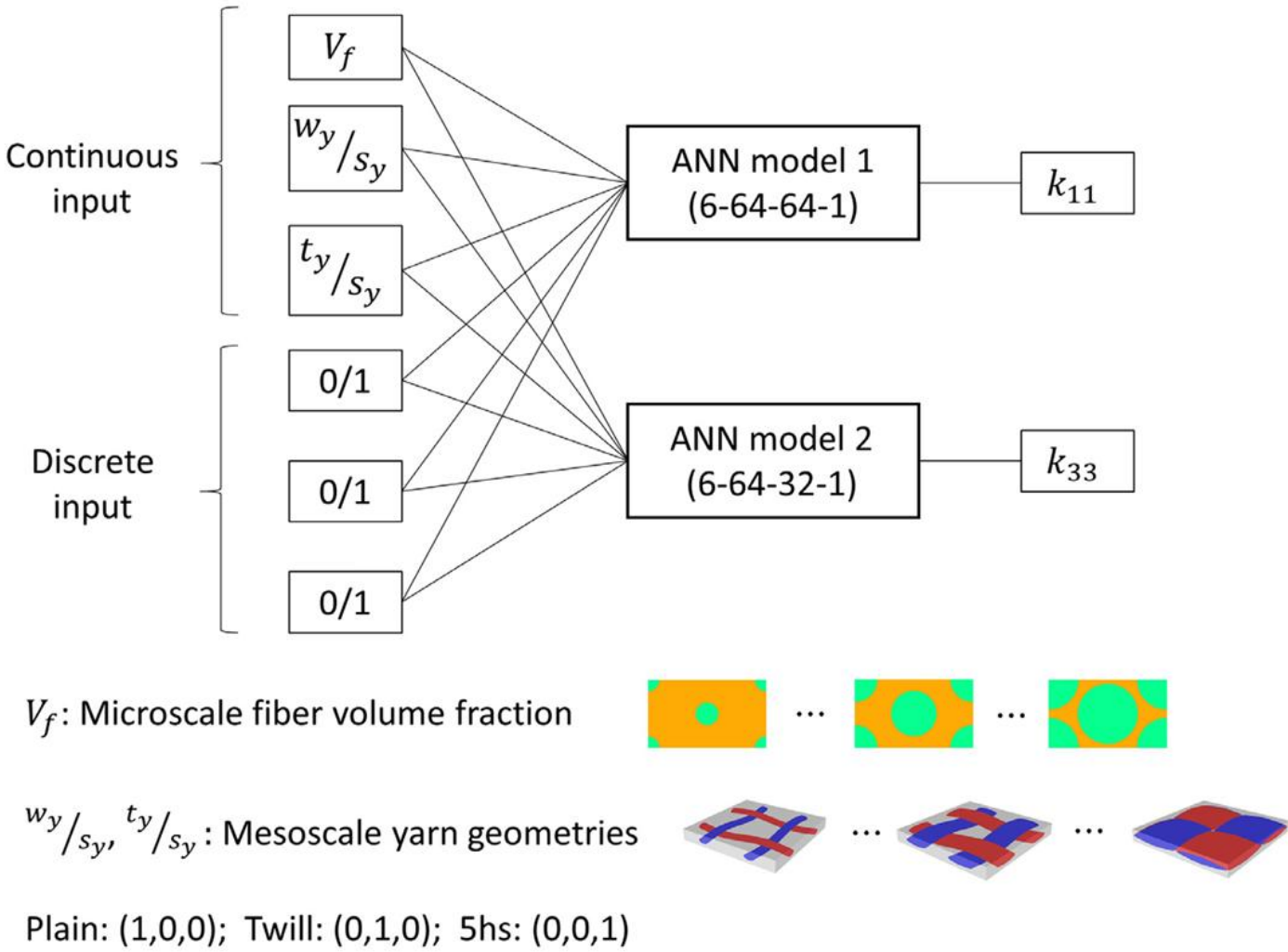


New feature addition to enable natural language inputs



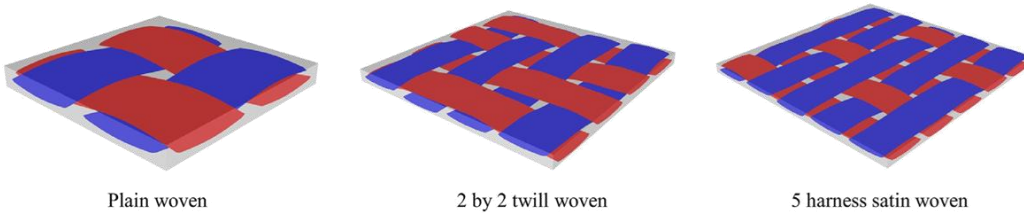
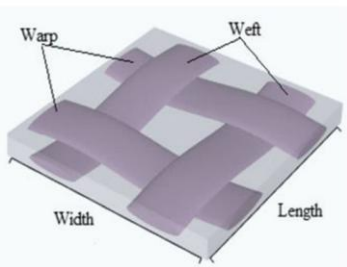
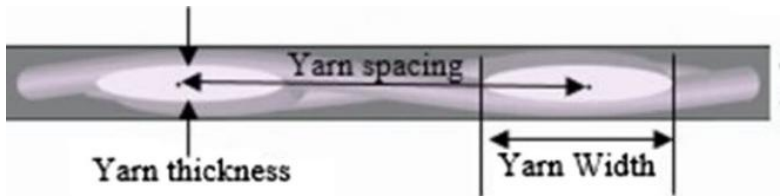
Note : This NLP implementation is not part of the original paper and is a feature addition

ANN architecture

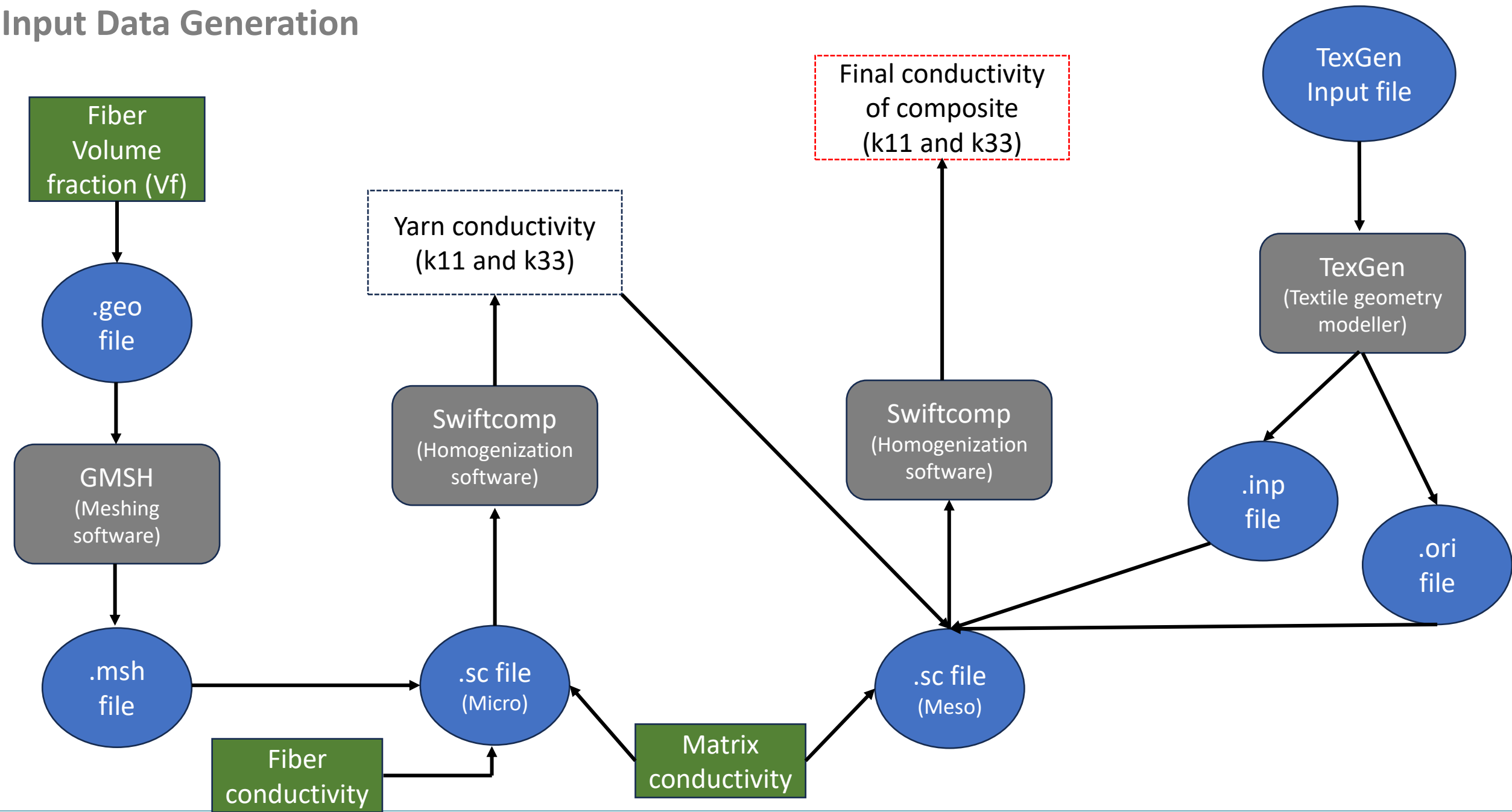


W_y / S_y – Ratio of Yarn Width to Spacing

T_y / S_y - Ratio of Yarn thickness to Spacing



Input Data Generation



Note on Input data generation

To generate the input data the following steps must be followed. The dependencies are required for the following tasks

- 2D geometry creation : GMSH
- Textile Fabric Modelling : TexGen
- MSG based Multiscale Homogenization : Swiftcomp

Steps :

1. Use Latin Hypercube Sampling (LHS) to create input data for the following inputs –
 1. Fiber Volume Fraction
 2. Yarn Width to Spacing Ratio
 3. Yarn Thickness to Spacing Ratio
2. Download and install GMSH from <https://gmsh.info/> (Opensource)
3. Swiftcomp is not an opensource software. It can be requested from Analyswift.
<https://analyswift.com/swiftcomp-vamuch-micromechanics-modeling-of-heterogeneous-materials-2/>
4. Download and install TexGen from Sourceforge - <https://sourceforge.net/projects/texgen/>

Note : There are 24000 data points to be generated. The estimated time would be 3-4 days or more depending on the PC configuration (due to multiple function calls)

The ANN model can be tested without any of these dependencies. This is just for input data and label generation. The working of this code is demonstrated in the video

Thank You