Design/Practical Experience [EEN1010]
Department of Electrical Engineering

Mid-term Report

Academic Year: 2021-22
Semester: 1

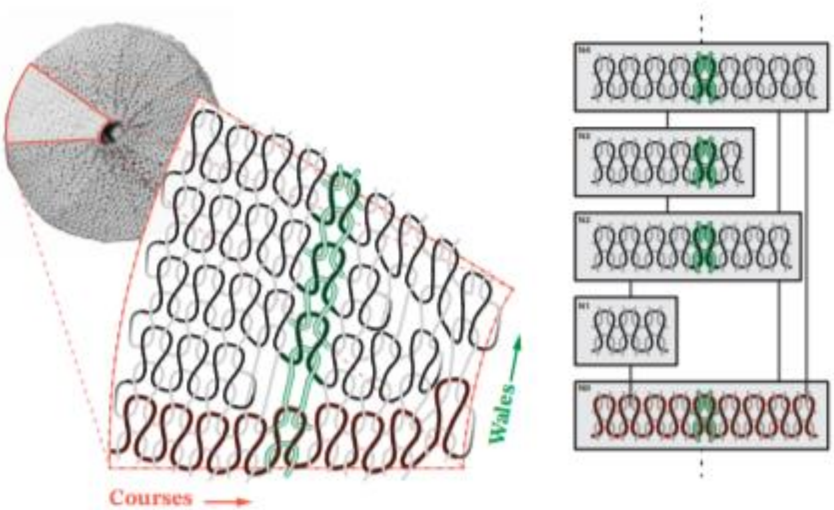
Date of Submission of Report:

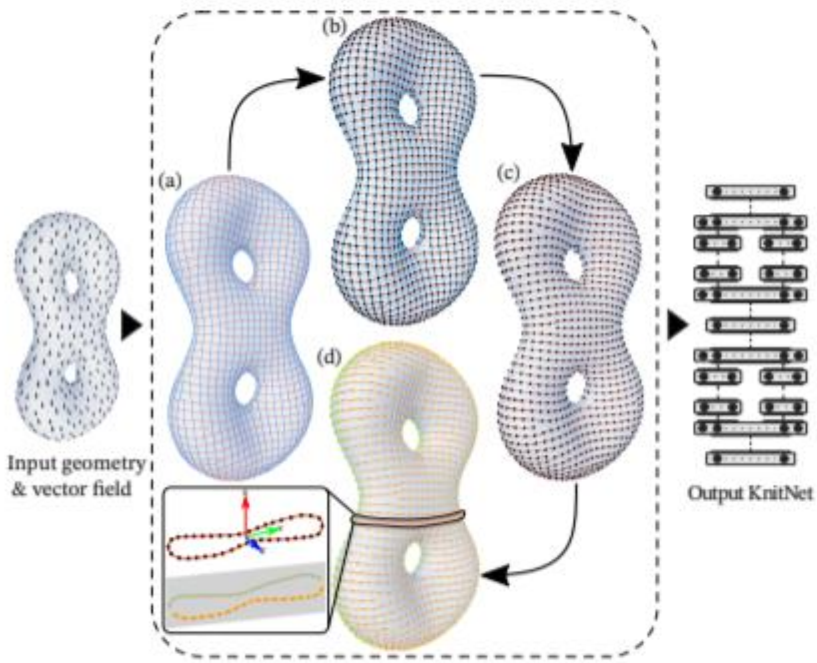
1. **Name of the Student: Divyam Patel**
2. **Roll Number: B20EE082**
3. **Title of the Project: Algorithm Development for Computational Knitting**
4. **Project Category: 3**
5. **Targeted Deliverables:**
   An implementation of an algorithm for computational knitting.

6. **Work Done:**
   Aim - The aim of the project is to develop computer-aided knitting design algorithm that allows freeform shaping and complex patterning with multiple types of threads.

   Theory -
   Recent developments in textile industries include digital and 3D textile manufacturing. Its application is not only limited to fashion and garments but in the engineering sector also like aerospace, automotive, defence sector. Functional properties such as electric, magnetic and thermal conductivity, light
   sensitivity, mechanical stiffness, or impact resistance can now be
   embedded in a fabric.
   Computational knitting is a modern technique that can transform 3D meshes, created by traditional modelling programs, directly into instructions for a computer-controlled knitting machine. Knitting machines are able to form knitted 3D surfaces from yarn. They also have some constraints on what they can fabricate.
   Given user-defined starting and ending points on an input mesh, the system incrementally builds a helix-free, quad-dominant mesh with uniform edge lengths, runs a tracing procedure over this mesh to generate a knitting path, and schedules the knitting instructions for this path in a way that is compatible with machine constraints.

Methodology:





Steps involved in building the KnitNet from an input 3D mesh and vector field

The process of building the KnitNet begins with a parameterization operation that produces orthogonal stripes with equal spacing. The spacing d between two consecutive stripes is controlled by setting the stripe frequency to $\omega = 2\pi/d$.

Having computed the stripe pattern, we now generate the vertices S of MQ by computing the intersection between two orthogonal stripes. At this stage, we can easily augment the vertices with any additional information given by the input texture maps, such as yarn information or stitch patterns. In practice, the texture resolution is rarely equivalent to the resolution of MQ. In order to deal with this mismatch, in our current implementation we compute the Voronoi cell for each vertex of MQ and project it onto the input triangular mesh. We then assign to each vertex the information corresponding to the most common pixel value within the projected Voronoi cell. Finally, we build an ordered list of the intersection points by tracing along each stripe on the input mesh, in the direction of its corresponding vector field.

KnitNet Data Structure:

It gives a topological structure of a knitted object. Some basic terminologies in KnitNet are:

Node: A node in KnitNet data structure refers to a set of ordered vertices that are connected in a course-wise manner.

Wale: It describes edge wise connections between courses.

Vertices: Ordered list of vertex, generally represents a stitch of the knit structure.

Template: User defined field to describe knitting pattern. Contains information about colour and material of yarn.

Work done till now - We have read the research papers and started working on the Algorithm.

7. References:

Nader, Georges, Yu Han Quek, Pei Zhi Chia, Oliver Weeger, and Sai-Kit Yeung. "KnitKit: A flexible system for machine knitting of customizable textiles." ***ACM Transactions on Graphics*** **(2021)**

8. Declaration:

I declare that no part of this report is copied from other sources. All the references are properly cited in this report.

I Patel

Rajendra Nagar

Signature of the Student **Signature of the Supervisor**