Past and Present in Mathematical Weaving
Abstracts

Session 1: (Zoom: 10:00-11:00)

Michael Friedman
Introduction

How can the different techniques of weaving be thought mathematically? Did different cultures derive from them different mathematical operations and insights? In which ways operations with weaving, braiding and strings prompt and aid mathematical thinking and new mathematical theorems, and how did historically weaving was considered mathematically and by mathematicians? The talk will attempt to sketch several directions of possible answers to this questions.

Ellen Harlizius-Klück
On the Relation of Arithmetic and Geometry in Ancient Weaving

This talk presents arguments for a possible connection of weaving and mathematics as well as reasons for deliberately disconnecting mathematics from weaving in antiquity along examples of patterning at the warp-weighted-loom. In doing this, specific emphasis is put on the relation of arithmetic and geometry. In addition, the thesis will be presented that (and why) the development of mathematical representations of weaves is not enhancing the possibilities of the weaver, but distorting the conditions of their work.

Sohpie Desrosiers
Practical weaving in numbers: a long history from the early 2000s back to the 3rd century BCE.

The Andean region is highly stimulating for understanding the relations between textiles and mathematics in the 'longue durée'. Many communities in the highlands of Bolivia and southern Peru weave today according to logical and thread counting principles evidencing a certain variety and are tangible in the warp-faced texture and more or less geometrical shapes of the local textile designs. Identifying their genealogy is no easy task as only few examples have been preserved because of the humid climate of the highlands unfavorable to the preservation of textiles. Nevertheless, among the thousands of archaeological textiles woven with distinct techniques that have been uncovered on the coast of Peru - thanks to its arid climate- , it has been possible to identify a few early items imported from the highlands and groups of items produced on the coast whose designs display close imitation of highland warp-faced texture and geometrical designs. These imitations are testimonies of the use in the highlands, since at least the 3rd century BCE, of the same logical and thread counting principles as those employed today.

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Session 2: (Zoom: 13:00-14:00)

Eric Vandendriessche
Mathematics of String Figures

In this presentation, I will give an overview of the contributions by some 20th-century mathematicians (Ali R. Amir-Moez, Ronald Read, Thomas Storer, Masashi Yamada...) who have developed different mathematical tools (symbolic writings, linear/heart sequences, diagram/invariant of knots...) in order to model the making of string figures (as practiced in various oral tradition societies worldwide).

Myf Evans
Geometric Modelling of Tangled Structures

The talk will introduce the use of geometric ideas in the characterisation and analysis of tangled structures. It will introduce the construction of idealised periodic tangles using ideas of both symmetry and homotopy of tangled lines on surfaces. These structures provide an extensive set of tangling motifs for the exploration of the behaviour of tangled microstructures in liquids. In order to probe this behaviour, I will show preliminary results of a new geometry based simulation technique that probes the morphology of filaments in a solvent.

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Session 3: (Zoom: 16:00-17:00)

Lorenzo Guiducci and Agata Kycia
Self-Shaping Textiles: How Geometric Design Weaves in 3D Shapes into Textiles

Since their appearance a few years ago, self-shaping textiles have fascinated designers, architects and engineers for their ability to efficiently convert a 2D pattern (3D printed on a prestretched textile) into a three-dimensional shape. Nonetheless these shape transformations are not trivial and a big theoretical, computational and experimental effort has been put in place to create tools and mathematical models that describe the morphing of a fabric into a desired target shape. In this contribution we attempt a (subjective and non-exhaustive) journey, which aims at tracing a possible history of this fascination, involving diverse disciplines and practices. In this framework, we introduce our personal exploration of 3D printing on pre-stretched textiles as an alternative, material-based, form-finding technique. We print bundles of parallel lines, analyze the resulting morphing through a simple mathematical model and use it as a design tool for creating three-dimensional textile surfaces. Finally we discuss the potential of this technique for designing efficient textile structures in architectural applications with optimized structural performance and minimal usage of material.

Konrad Polthier
Islamic Art and Beyond – Tilings and Weavings in 3D

Starting from 2D Girih tilings in Islamic art we analyse the underlying construction principles and embark to 3D Girih. Covering and weaving techniques we also introduced in recent industrial algorithms in computer aided design and geometry processing, and we highlight mutual relations between art, applications and mathematics.

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Final session: (Zoom: 17:00-17:45)

Wolfgang Schäffner
Turning Points and Angles of Weaving

The birth of Greek geometry is generally related to surveying practices and tools, such as the gnomon, considered as a inherent cultural technique. Geometric operations that include measuring and calculating are done by drawing lines, threads or rods, casting shadows and plumb lines, thus processing and storing the operations by geometric proportions. Nevertheless, weaving is not mentioned in texts of ancient geometry. On the other hand, weaving and the loom has been analyzed (especially by Ellen Harlizius-Klück) as a calculating device where the counting of yarns was a basic operation of weaving. Ancient weavers used a discrete, always countable abacus like system of two types of yarns (warp and weft), so that all figures consist of combinations of integers of binding points. The design of complex patterns, thus, was the result of arithmetic operations.

Therefore, the basic question I want to raise in my talk is about what constitutes the fundamental connection between weaving and the loom with geometry. To what extent there can be described a basic geometric system that makes weaving possible? How can the binding points and threads be described as analog weaving operations in terms of continuous geometric operations? Focusing on turning points, angles and some basic geometric devices from Oenopides, Aristotle, to Euclid and Heron, I try to describe geometric operations of weaving that can be otherwise be handled by the arithmetical control of counting the threads.