Bi-Axial Woven Tiles: Interlocking Space-Filling Shapes Based on Symmetries of Bi-Axial Weaving Patterns

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In this paper, we introduce a framework for the geometric design and fabrication of a family of geometrically interlocking space-filling shapes, which we call woven tiles. Our framework is based on a unique combination of (1) Voronoi partitioning of space using curve segments as the Voronoi sites and (2) the design of these curve segments based on weave patterns closed under symmetry operations. The underlying weave geometry provides an interlocking property to the tiles and the closure property under symmetry operations ensure single tile can fill space. In order to demonstrate this general framework, we focus on specific symmetry operations induced by fabric weaving patterns. We specifically showcase the design and fabrication of woven tiles on flat and curved domains by using the most common 2-fold fabrics, namely, plain, twill, and satin weaves. We further evaluate and compare the mechanical behavior of the so created woven tiles through finite element analysis.

https://www.youtube.com/watch?v=oCpYTyN2ELU

Learning Geometric Transformations for Parametric Modeling: An AR-Powered Approach

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Geometric Transformation is an essential topic in parametric modeling, which supports exploration of architectural design solutions. In learning transformations, students face difficulties understanding the association between geometric and algebraic representations of transformations. Augmented Reality provides an opportunity for enhancing the learning of transformations utilizing AR’s integration of embodied learning and virtual augmentation of mathematical information on physical transformations. Based on a prior AR for assembly project – BRICKxAR, the authors are developing an AR application for creating an immersive environment for architectural students to improve understanding of mathematical concepts and fundamentals of parametric and computational design through learning transformations and their matrix math in an intuitive way. The application is intended to utilize the conceptions of “motions, mappings, and functions” for understanding transformations, suggested by literature. A spatiotemporal alignment of information between digital and physical transformations is achieved in the AR environment. A 4×4 transformation matrix is visualized in runtime display as a representative matrix of fundamental 3D geometry transformations such as rotation, translation, and scale. The developed user interface lets students interact and play with the transformation functions as an object in runtime to transform the digital model while visualizing the pre- and post-images of the transformed model. The corresponding orientation and distance dimensions are superimposed on the physical manipulation to help students track the transformation history. LEGO Arc de Triomphe model is used as a case study in this experiment. The study intends to reduce cognitive load in learning fundamental mathematics in an intuitive way and improve architectural students’ spatial and math skills, which are further needed for parametric and computational design.
Interactive VR Simulations for Medical and Nursing Education

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Soft Interaction Lab presents interactive VR simulation research focusing on Medical and Nursing education. During the demo session, we are going to demonstrate Human InNervate VR and Antepartum Assessment 360. These are ongoing collaborative projects with faculty members from the Department of Veterinary Integrative Biosciences and College of Nursing.

Human InNervate VR explores the complex relationship between motor nerve deficits and their effects upon the human anatomy’s ability to produce movement. This app consists of two learning modules. The first is designed to give the same baseline labeling and identification that other anatomy education applications offer. The second module allows the user to become more actively engaged and to explore the relationship between motor nerves and the muscles through the use of interactive animation simulations. Antepartum Assessment 360 is an interactive 360 video that demonstrates a patient’s office visit for an antepartum assessment during pregnancy. This covers the use of a gestational wheel, fundal height measurement, Leopold’s maneuvers, fetal heart rate assessment, and edema assessment.