**Technion-Israel Institute of Technology**

**Computer Science Department**

**Center for Graphics and Geometric Computing**

# CGGC Seminar

**13:30-14:00**
**Boris van Sosin**

Computer Science Department, Technion-Israel Institute of Technology

## Untrimming: Precise conversion of trimmed surfaces to tensor-product surfaces

Trimmed B-spline surfaces are very common in the geometric computer aided design (CAD) community due to their capability to represent complex shapes that cannot be modeled with ease using tensor product B-spline and NURBs surfaces. However, in many cases, handling trimmed-surfaces is far more complex than tensor-product (non-trimmed) surfaces. Many algorithms that operate on tensor-product surfaces, such as algorithms toward rendering, analysis and manufacturing, need to be specially adapted to consider the trimming domains. Frequently, these special adaptations result in lack of accuracy and elevated complexity.

A recent development in physical analysis, Iso Geometric Analysis (IGA), performs the analysis directly in spline spaces over the tensor product surfaces of the models. In practice, however, industrial geometric models heavily exploit trimmed-surfaces. While IGA requires precise integration over the surfaces, among others, integration over trimmed B-spline basis functions is a challenging and non-trivial task, in general. Approximating trimmed-surfaces by piecewise-linear elements, in order to simplify the integration process, typically result in loss of accuracy and might affect the quality and convergence of the analysis. Methods to precisely integrate over the trimming domains are required, in order to have a complete and accurate IGA over trimmed-surfaces. One step towards achieving this goal is by converting the trimmed-surfaces to tensor-products.

In this work, we present an algorithm for precisely converting trimmed surfaces into a set of tensor-product (typically B-spline) surfaces. The algorithm suits the needs of IGA since the generated tensor-product surfaces are guaranteed to be non-singular in the domain's interior. First, the algorithm divides the parametric space of the trimmed surface into four-sided quadrilaterals with freeform curved boundaries. Then, the quadrilaterals are parameterized as planar parametric patches, only to be lifted to the Euclidean space using a surface-surface composition. The algorithm is robust and precise.

We show that we can handle complex, industrial level, objects, with numerous high order rational surfaces and trimming curves. Finally, the algorithm can provide user control on some properties of the generated tensor-product surfaces.

**14:00-14:30**
**Boris van Sosin**

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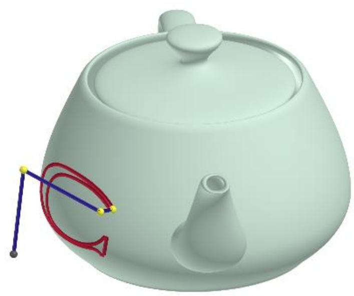
## Solving Piecewise Polynomial Constraint Systems with Decomposition using Subdivision-Based Solver

Piecewise polynomial constraint systems are common in numerous problems in computational geometry, such as constraint programming, modeling, and kinematics. In this talk, we present a framework that is capable of decomposing, and efficiently solving a wide variety of complex piecewise polynomial constraint systems. The framework we present uses a constraint system decomposition algorithm to break down complex problems into smaller, simpler subproblems. It then solves the subproblems using a subdivision-based polynomial solver, and propages the results from one subproblem to the next using multivariate functional composition. Our framework supports problems with either zero-dimensional or univariate solution spaces, and also include both zero constraints and inequality constraints.

We will demonstrate the capabilities of our framework on several problems, from simple "point-and-bar" systems through complex kinematic problems to general algebraic problems, and compare its performance to the subdivision-based polynomial solver without decomposition.



**The lecture will be held on Sunday, 21.5.2017, at 13:30, Taub 401**

**הזמנה זו מהווה אישור כניסה עם רכב לטכניון**