ALGEBRA & DISCRETE MATHEMATICS SEMINAR

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Subdivision Algorithms for Guaranteed Correct Computations

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When performing a computation, one may make a choice between symbolic and numerical techniques. Symbolic techniques have the advantage that they are globally correct, but the disadvantage that they are time consuming. Numerical techniques, on the other hand, are typically fast, but allow more limited correctness statements. Recently, attention has been focused on hybrid techniques that combine symbolic and numerical techniques.

In this talk, I will focus on hybrid subdivision algorithms. Subdivision algorithms iteratively subdivide an initial domain into smaller and simpler domains which are easier to characterize. These algorithms are typically recursive, making them easy to implement, and are adaptive, performing more subdivisions near difficult features and less work elsewhere. For such algorithms, there are two common challenges: it is difficult to determine the number of subdivisions performed and it is sometimes difficult to guarantee the global correctness based solely on local correctness statements.

I will discuss solutions to both of these problems via two hybrid subdivision-based algorithms. The operations performed by these algorithms are entirely numerical, but the correctness is justified with symbolic arguments. The first algorithm computes a piecewise-linear approximation to a planar algebraic curve.

Even though the operations performed by the algorithm are numerical, it is guaranteed to produce a topologically correct approximation, even in the presence of singularities. This is the first numerical algorithm with such a correctness guarantee. I will then consider a one-dimensional version of this algorithm and show that the number of subdivisions compares favorably with common symbolic subdivision algorithms. This will show that these hybrid subdivision-based algorithms are both efficient and accurate.

For further information, contact Matthew Macauley, macaule@clemson.edu, 656-1838, Martin O-325.
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