Project Proposal
CPSC 645 Geometric Modeling

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Generation of grids to support computation across objects
Description of problem: My project topic is ‘generation of grids to support computation across geometric object’. To perform scientific computation, we need to generate grids and then only we can discretize the governing equation and solve it numerically. Grid generation is a very challenging research area because quality of solution depends on the grid used. A quality grid should be as orthogonal as possible and there shouldn’t be abrupt changes in the grid. Generally non-uniform grids are needed to perform scientific computations. We should have control over the grid density so that we can have fine grid in the areas where variable gradient is very high. Aim of my project is to generate 2D and 3D grids with proper control over grid properties.

Importance of the problem: Experiments are generally cumbersome, costly and time consuming. Alternative to these experiments is scientific computation. We model physical phenomenon and generally get partial differential equations (PDE) governing the process. Generally it is not possible to solve these PDEs analytically. So we rely on numerical methods like Finite Difference Method, Finite Element Method etc. To solve a PDE in a domain, we need to discretize the domain. We divide the whole domain into small-small elements. This process is called grid generation. The importance of grid generation is evident from the fact that no computation can be performed without generating grid (except some mesh-less methods).

Previous work on the problem: Grid generation is one of the areas where so much work has been done. Generating grid in a complex domain is quite challenging. There has been so much research on controlling grid properties (Orthogonality, skewness).

My proposal: My work will include (may extend)

1. Grid generation in 2D and 3D domain (e.g. grid generation around circular cylinder, 3D cavity etc).
2. Grid refinement study (control on the parameters)
3. Grid generation for domain having complex boundaries.

At this point of time I don’t know much about how CADD is helpful in generating better grids. So I will complete my proposal when I submit my first project update.

Originality: There is so much work being done in grid generation area. My work will be original in the sense that it will integrate CADD with grid generation and will generate grids effectively. Boundary representation will be more accurate in my work.

List of goals: As mentioned above my goal would be to generate grids effectively. Following would be my schedule

First update report: Writing basic code to generate grids.
Second update report: Improvement in grid quality.
Final report: Generating grid for domains having complex boundaries.

As I have mentioned above, my project will integrate CADD with grid generation. At this point of time I am not very sure how CADD can help generating better grids so above mention schedule is tentative and I may do other things as well.