Exercise 3: Algebraic Curve, Surface Splines - III

CS384R, CAM 395T, BME 385J: Fall 2007

September 18, 2007, Due: October 1, 2007

Question 1. Consider the normal r-offset surfaces Q_{outer} and Q_{inner} of an algebraic surface patch P inside a tetrahedron, where Q_{outer} is the offset in the positive surface normal direction and Q_{inner} is the offset in the negative surface normal direction by r. If patch P is defined by a quadratic trivariate polynomial equation, give the equation of the Q_{outer} and Q_{inner} surfaces and the patch boundaries within a r-offset (or r-scaled) tetrahedron.

Question 2. Given a union M of n spheres (simple geometric model of a molecule), give an efficient algorithm to generate the r-offset M_r^+ and M_r^- models of M where again M_r^+ is the outer offset and M_r^- the inner offset. What is the relationship of the inner r-offset $(M_r^+)_r^-$ of M_r^+ with M? Provide an algorithm to generate a model of $(M_r^+)_r^-$.

Question 3. Consider a parallel n-stack of n-circles of different radii with one circle per plane, and at possibly a different location (center) in each plane. Provide an A- patch representation of a smooth surface spline which C^1-interpolates the stack of n-circles.

Question 4 . Consider a pair of non-parallel planes P_1 and P_2, where the dihedral angle between P_1 and P_2 is less than forty-five degrees. Let there be a single circle C_1 on P_1 and two circles C_2 and C_3 on P_2, all of different radii and at different locations (center) in each plane. Describe a method of generating a family of smooth low degree surface splines which C^1-interpolates (joins) the circles C^1, C_2 and C_3. What is the algebraic and geometric degrees of your surface spline ? What parameter family did you generate ? Provide additionally a construction that describes, either an A-patch or a tensor-product B-spline patch representation of this smooth surface family.