DOKTORAND:	Heidi Elisabeth Iuell DAHL
GRAD:	Philosophiae doctor
FAKULTET:	Det matematisk-naturvitenskapelige fakultet
INSTITUTT:	Institutt for informatikk
FAGOMRÅDE:	Geometri for Computer Aided Design
VEILEDERE:	Tor Dokken
	Rimvydas Krasauskas
	Knut Mørken
DISPUTASDATO:	23. oktober 2014

AVHANDLINGENS TITTEL: *Improved blends between primitive surfaces*

In Computer Aided Design (CAD), and in particular in the design of mechanical parts, complex shapes are constructed from a limited set of primitive surfaces: planes, the natural quadrics (spheres, right circular cones and cylinders), and blending surfaces creating smooth transitions between them. In current CAD systems blends are typically constructed by approximation, allowing gaps within fine tolerances between adjacent surface patches. In Finite Element Analysis (FEA), however, adjacent elements are required to match exactly in order to have watertight models. The disparities between the priorities of design and analysis models cause a major bottleneck in the traditional computer aided design-analysis-redesign cycle.

The main results of this thesis are exact rational parametrizations of two types of blends between natural quadrics. The blending surfaces match the original surfaces exactly, ensuring a watertight model suitable for both design and analysis.

The first blend type is rolling ball blends, a classical construction where the blending surface is described by a ball rolling along the two surfaces. We provide closed formulae for the blend parametrizations where possible, as well as general parametrization algorithms for rolling ball blends with fixed and variable radius. We describe the differential geometry of rolling ball blends, and give the conditions for joining two blend segments smoothly together with tangent and curvature continuity. These results are applied in the construction of composite rolling ball blends.

The second blend type is a new class of blending surfaces constructed as duals of rational surfaces in isotropic space, i.e., we model the blending surface by describing its tangent planes. In order to construct low degree blends, we classify quadratic surfaces in isotropic space and describe the families of cones tangent to their duals in Euclidean space. These results are extended to singular isotropic cyclides, a more general class of surfaces whose duals are also well-suited for cone/cone blends.