ABSTRACT

This thesis presents a framework of B-spline neural networks for geometric modeling. The classical approaches of geometric approximation problem have been investigated enormously in past decades. However, most of these approaches depend strictly on mathematic optimization tool which is too expensive to compute as the system becomes complex. Artificial neural networks, on other hand, inspired by biological neural model can be viewed as a graphical notation for a large class of optimization algorithms. A novel idea of integration artificial neural networks model into geometric modeling should be tried. In particular, we attempt to show that geometric modeling problem can be solved efficiently by B-spline neural networks learning framework. The standard problem of geometric modeling is reduced to an approximation task which is solved by the learning process of B-spline neural networks from observation data points.

To train the networks, a gradient descent algorithm is presented to optimize the coefficient weights. We examine different parametric curves based on their arc-length and curvature characteristics. It turns out that the B-spline neural networks with fixed knot can model well all parametric curves without sharp angle. To exploit the power of B-spline approximation, a free knot approach is integrated for the learning task of B-spline curve modeling framework. An evolution learning algorithm is presented for globally optimizing both coefficient weights and knot parameters of the networks. We investigate the evolution learning algorithm on different sets of curves. The result turns

out that B-spline neural networks which incorporates variable knot into optimization can efficiently model parametric curves even with rapidly sharp angle.

Furthermore, we present a framework of B-spline neural networks to surface modeling problem. The architecture of propose tensor product B-spline neural networks is extended in a straightforward way from the neural architecture of curve modeling. The evolution free knot learning algorithm is adapted to train the tensor product networks.