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NURBS CURVE FITTING USING ARTIFICIAL IMMUNE SYSTEM

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Abstract. *Non-Uniform Rational B-spline (NURBS) is an industrial standard for Computer Aided Design (CAD) model data representation. For constructing an CAD model from a physical part by curve modeling and dimensional measure, the NURBS design often results in a multi-objective optimization (MOO) problem which cannot be handled as such by traditional single objective optimization algorithms. For large data, this problem needs to be dealt with non-deterministic optimization algorithms achieving global optimum and at the same time getting to the desired solution in an iterative fashion. In order to find a good NURBS model from large number of data, generally the knots, control points and weights are respected as variables. In this paper, the minimization of the fitting error is aimed in order to find a smooth curve and the optimization of the NURBS weights and the knot vector for curve fitting is worked. The heuristic of Artificial Immune System (AIS) was used as a new methodology. The best model was searched among the candidate models by using the Akaike's Information Criteria (AIC). Numerical examples were given in order to show the efficiency of our method.*
Keywords: Curve approximation, Artificial immune system, NURBS, Control points, Knots

1. **Introduction.** Curve fitting is widely used in applications of many fields such as image processing, computer graphics, industrial and computer-aided design (CAD) and computer-aided manufacturing (CAM) for vector-based drawing, font design, data reduction, approximating noisy data, curve and surface fairing, visualization and approximation. Recently, researchers have spent considerable time figuring out how best to fit curves to a set of data points. Although researchers used analytical function for curve fitting the input data, since the shape of the underlying function of data is frequently complicated, it is difficult to approximate it by a single polynomial. In this case, an appropriate spline model and its variants are the most appropriate approximating functions [1]. Non-uniform rational B-splines (NURBSs) have various useful properties such as smoothness and the possibility of local modifications, which facilitate the representation of general freeform surfaces. These properties of NURBS are ideal for the design of complicated geometry, making them a standard tool in computer-aided design and manufacturing (CAD/CAM). A kth degree B-spline curve is uniquely defined by its control points and knot values, but for NURBS curves, the weight vector has to be specified [2].

Since the NURBSs consist of multi-parameters, control points, knots and weights, the rational format of the objective function makes the fitting task a multi-variable nonlinear optimization problem. Although various algorithms exist for nonlinear optimization