

NURBS with Lagrangian Dynamics

We present a dynamic version of the Non-Uniform Rational B-Spline model. NURBS have become a *de facto* standard in industrial CAD systems because of their power to represent both free-form and common analytic shapes. To date, however, NURBS have been viewed as purely geometric primitives, which require the designer to interactively adjust many degrees of freedom (DOFs)—control points and associated weights—to achieve desired shapes. Dynamic NURBS, or D-NURBS, are physics-based models that incorporate mass distributions, internal deformation energies, and forces into the NURBS geometric substrate. A set of nonlinear dynamic differential equations are integrated numerically to evolve the DOFs. Consequently, D-NURBS move and deform in a physically natural manner when directly manipulated. Using D-NURBS, a modeler can interactively design complex shapes not only by adjusting DOFs, but also by applying forces and specifying local and global shape constraints. Dynamic NURBS are effective tools in a wide range of applications such as solid rounding, surface fitting, shape metamorphosis, and free-form deformation.

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