

Lian Zhou, Xin-hui Lin, Hong-yan Zhao, Jun Chen, 2017. Optimal multi-degree reduction of C-Bézier surfaces with constraints. *Frontiers of Information Technology & Electronic Engineering*, **18**(12):2009-2016.
<http://dx.doi.org/10.1631/FITEE.1700458>

Optimal multi-degree reduction of C-Bézier surfaces with constraints

Key words: C-Bézier surfaces; Degree reduction; Boundary constraints

Corresponding author: Lian Zhou

E-mail: lianzhou@shmtu.edu.cn

 ORCID: <https://orcid.org/0000-0001-7137-0162>

Motivation

- By using C-Bézier model, repeated differentiation and integration can get rid of high-degree curves and surfaces.
- Compressing data, finding intersection between two surfaces, and computing roots of polynomials are based on degree reduction.
- An ideal algorithm for degree reduction of C-Bézier surfaces is needed.
- The algorithm should have the following characteristics: (1) multi-degree reduction at one time, (2) certain constraints, (3) best precision.

Main idea

- The explicit expression of C-Bézier basis can be given in a matrix form.
- The constrained control points of the degree-reduced surfaces is prescribed.
- Divide and conquer is an excellent strategy to determine the unconstrained control points of the degree-reduced surfaces.

Method

1. We give the explicit expression of C-Bézier basis in a new space.
2. We present multi-degree reduction of C-Bézier surfaces in the norm L_2 with prescribed constraints based on the geometric joining condition.
3. The unconstrained control points of degree-reduced surfaces are determined using least square method.

Major results

- The resulting piecewise approximating surfaces are globally G^1 continuous.

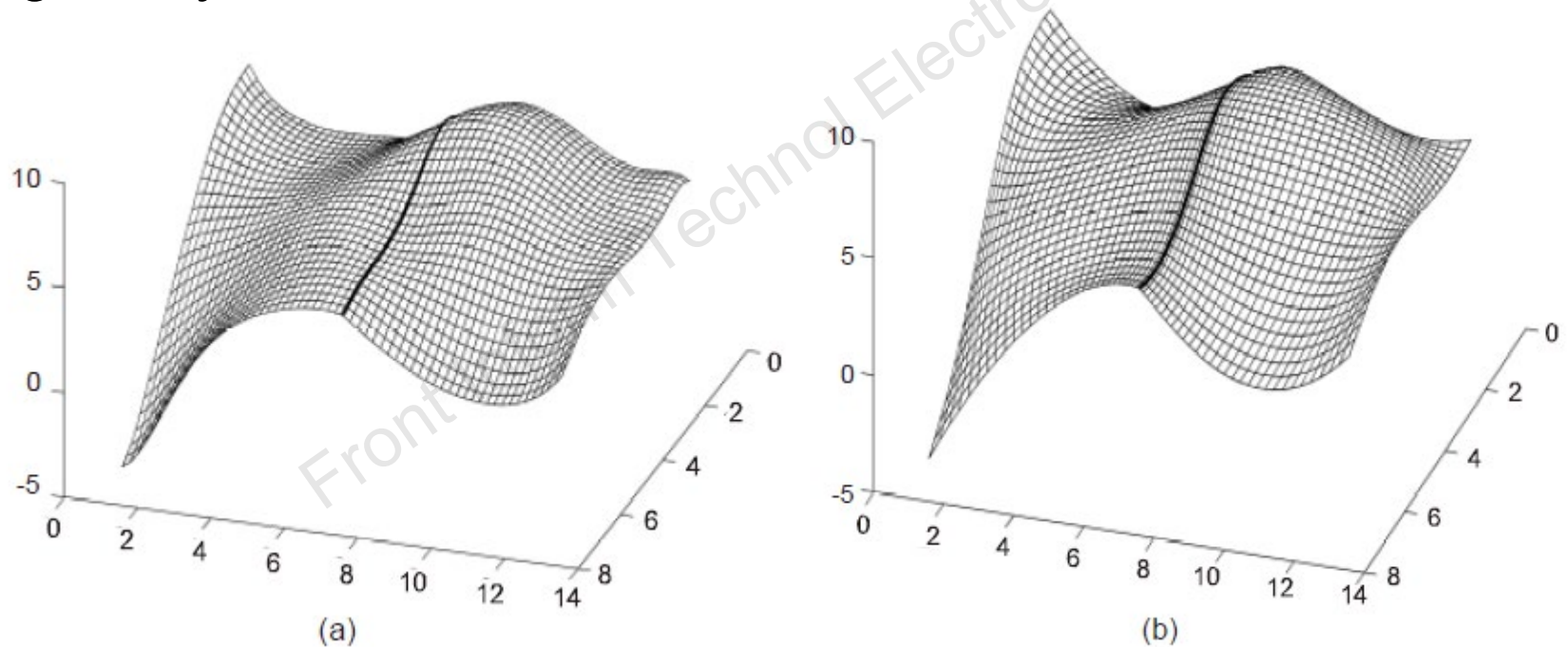


Fig. 4 Two G^1 joined degree 6×6 C-Bézier surfaces (a) and two G^1 joined 3×3 degree reduced surfaces with boundary constraints (b)

Conclusions

- We calculate the transfer matrix of C-Bézier basis in space $\{1, t, \dots, t^{n-2}, \sin t, \cos t\}$.
- We present an optimal method for degree reduction of C-Bézier surfaces.
- Numerical examples show that our method is effective.