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Degree elevation of unified and extended spline curves

Key words: Degree elevation, Unified and extended (UE)-splines, Bi-order UE-splines, Corner cutting, Geometric explanation

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Motivation

- UE-splines include B-splines, NUAT B-splines, NUAH B-splines, and much more various forms by introducing complex numbers
- A low order UE-spline curve can be represented as a higher order UE-spline curve because of the same continuity at interior knots
- Our interest is the degree elevation algorithm of UE-spline curves and its geometric meaning

Method (I)

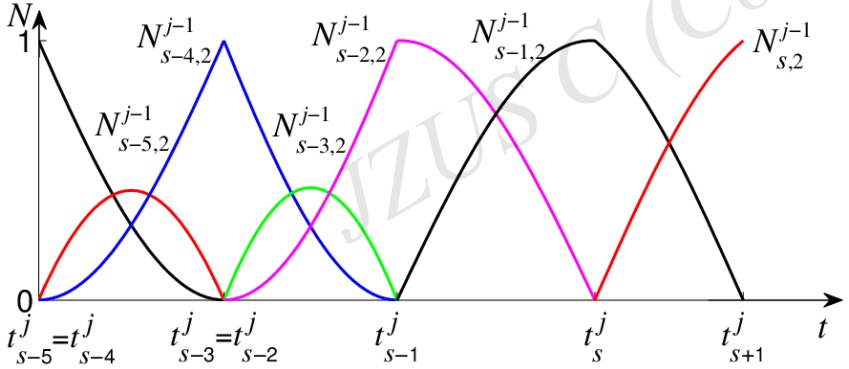
- Key: **Continuity**
- Main method:

  Knot insertion at **every interior knot**

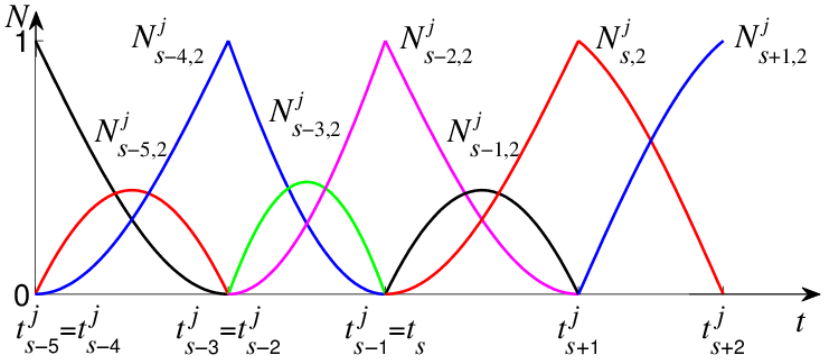
  Insert knots **one by one**

Method (II)

- Introduce bi-order UE-spline curves
- Obtain the transformation formulae of the basis functions before and after inserting a interior knot into the knot vector



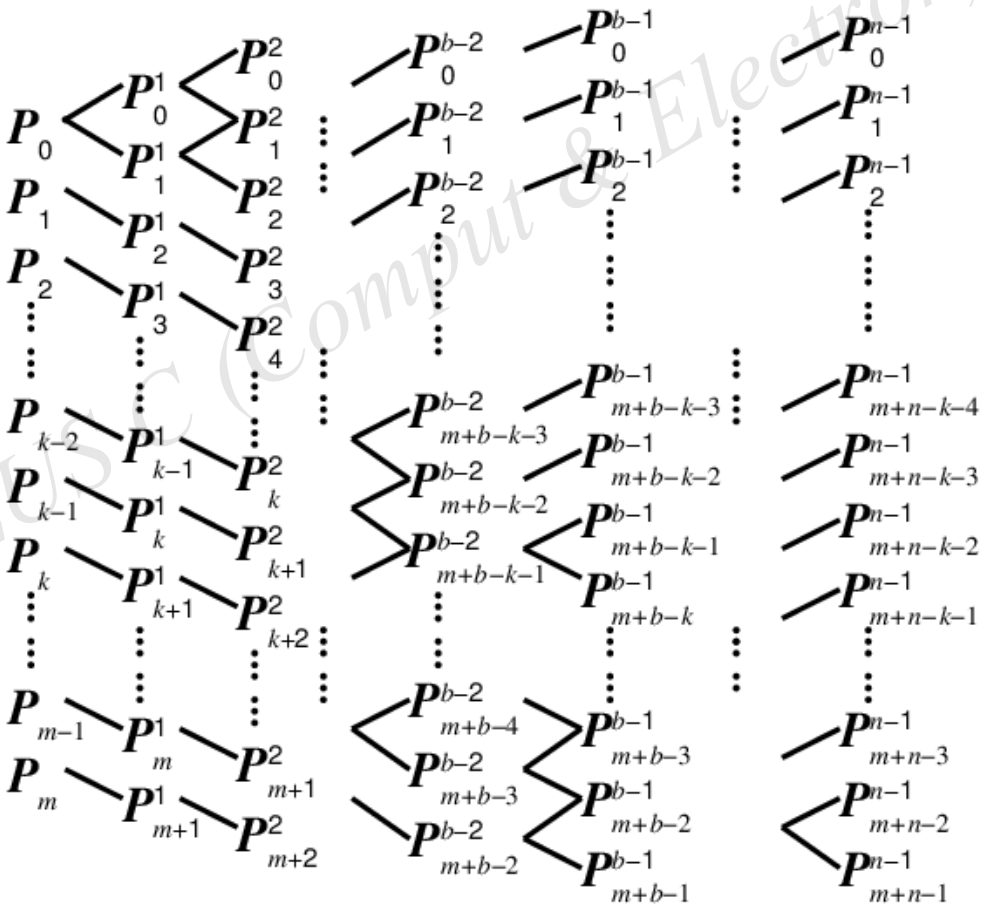
The basis functions before inserting t_j



The basis functions after inserting t_j

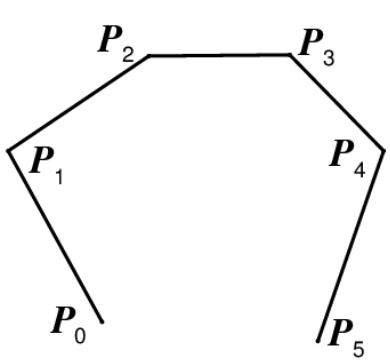
Results

- The degree elevation of UE-spline curves can be interpreted as a corner cutting process

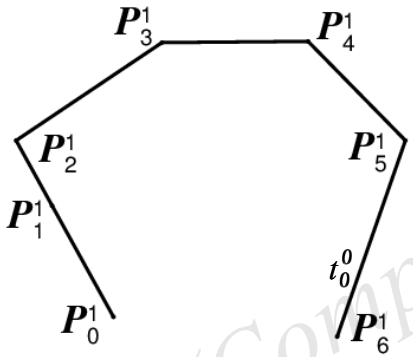


Results

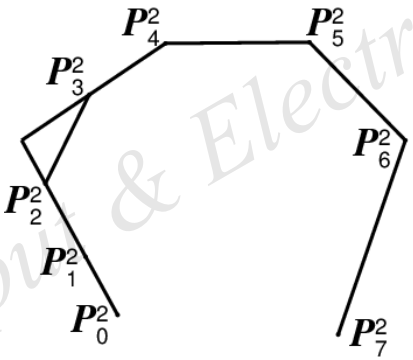
Degree elevation for UE-spline of order four on $T = \{t_0^0, t_1^0, \cdots, t_9^0\}$ where $t_0^0 = t_1^0, t_4^0 = t_5^0$



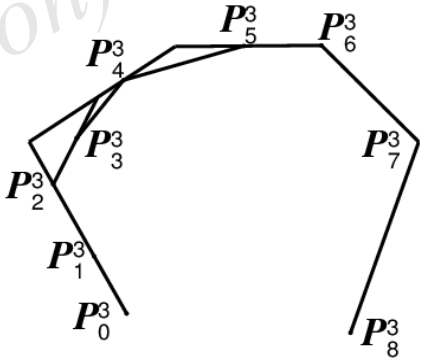
Original control polygon



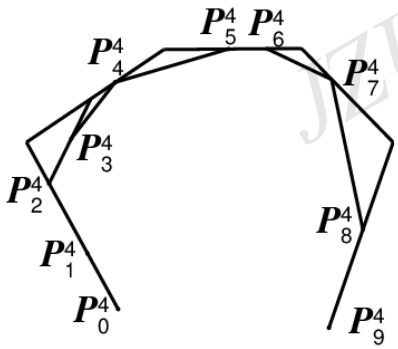
insert t_0^0



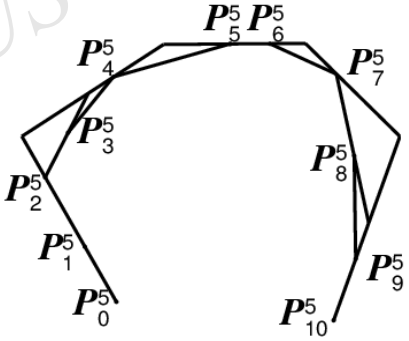
insert t_2^0



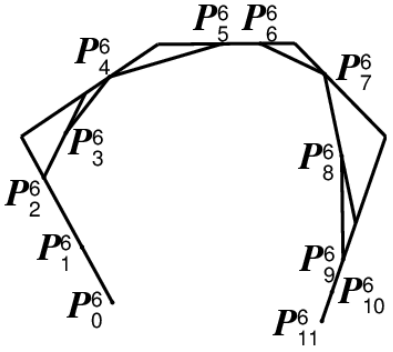
insert t_3^0



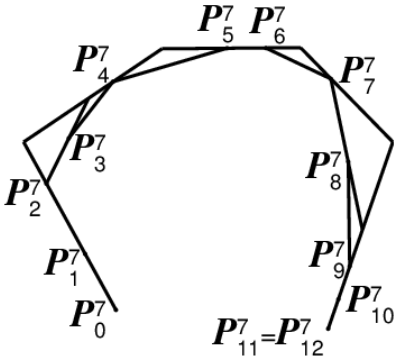
insert t_4^0



insert t_6^0



insert t_7^0



insert t_8^0

Conclusions

- A degree elevation algorithm for UE-spline curves is proposed
- The algorithm can be interpreted as a corner cutting process on the control polygon