Technical note: Cubic and bicubic spline interpolation in Python

This page contains the source codes associated to the HAL technical note for setting up and plotting cubic splines and bicubic parametric surfaces with various end conditions.

Download pdf and Python 3.8 files

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File types

Technical note:

- pdf file

Cubic splines:

- free end condition
- imposed tangent direction
- end-to-end tangent continuity
- not-a-knot end condition

Bicubic parametric surfaces:

- free end condition
- cylindrical closed surface
- spherical closed surface
- not-a-knot end condition

Abstract

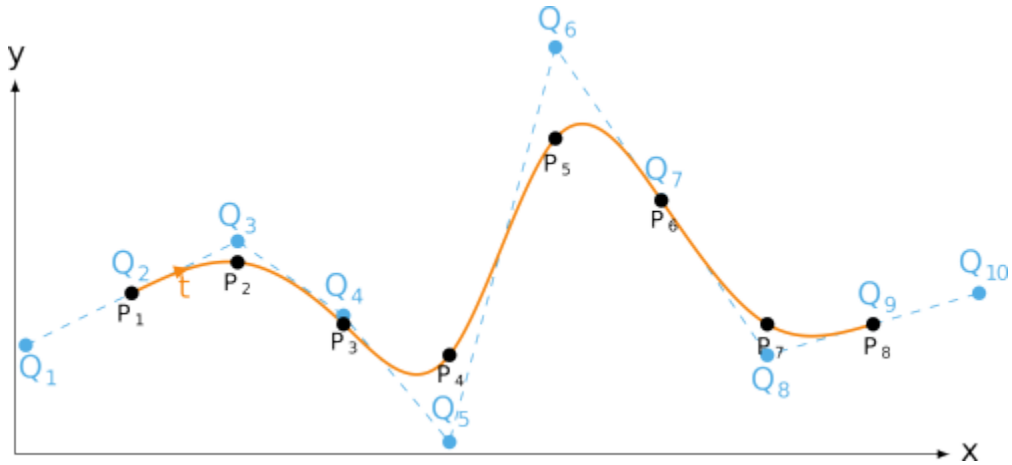
Cubic and bicubic spline interpolations are widely used in a variety of domains. Nonetheless, there are limited resources available to help students or professionals who wish to implement these tools within a computer program. Be it for visualization purposes or for use within sophisticated algorithms, building a 2D or a 3D spline may not be a straightforward process. In this context, the present technical note provides a brief theoretical description of both splines and bicubic splines but also focuses on the practical implementation of both concepts with an emphasis on the various types of boundary conditions that may be used. In particular, different configurations featuring free end conditions, not-a-knot end conditions or particular tangent orientations to build both open and closed parametric curves and surfaces are detailed. Several source codes—written in Python 3.8—are provided with the intent to facilitate the reproduction of presented results. Proceed to the bottom of the page for an overview of

practical examples.

2D cubic spline

free end condition

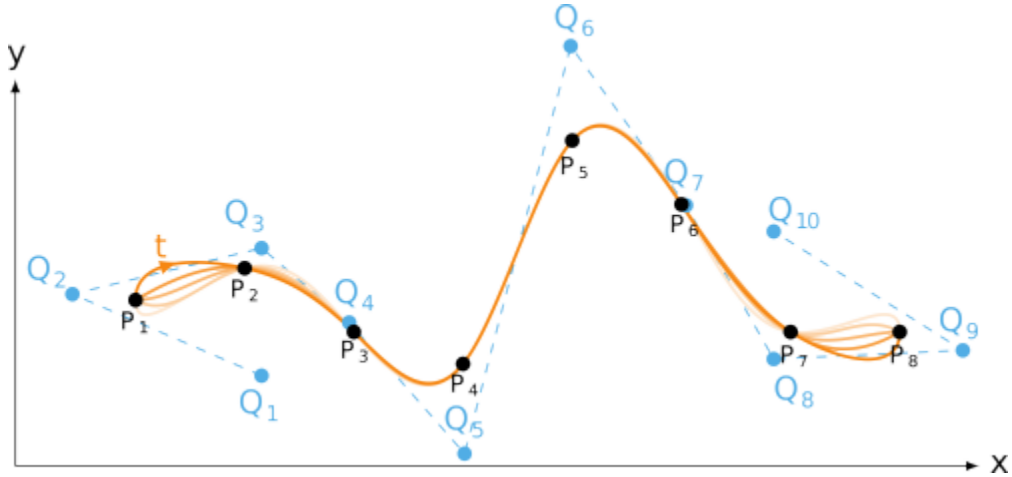
Python source code: free end condition



cubic spline interpolated on a set of fit knots with free end conditions

imposed tangent direction

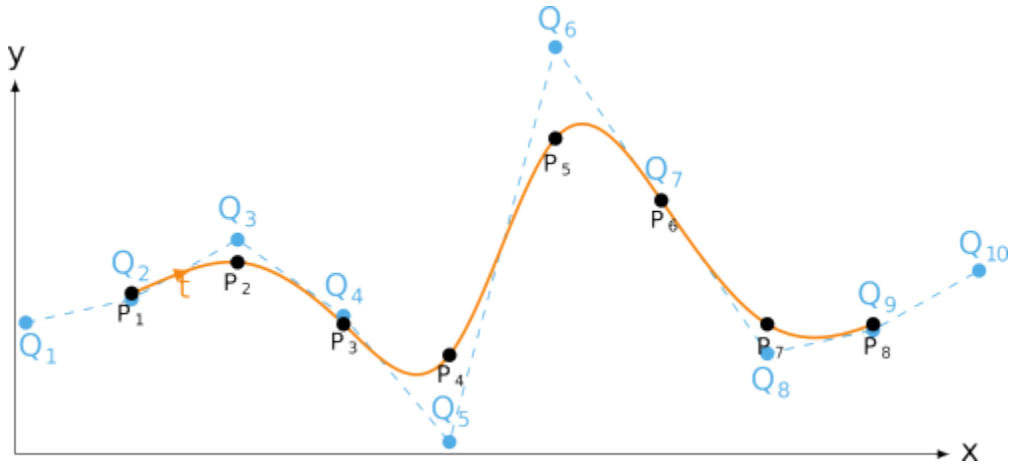
Python source code: imposed tangent direction



cubic spline interpolated on a set of fit knots with imposed tangent directions at ends

end-to-end tangent continuity

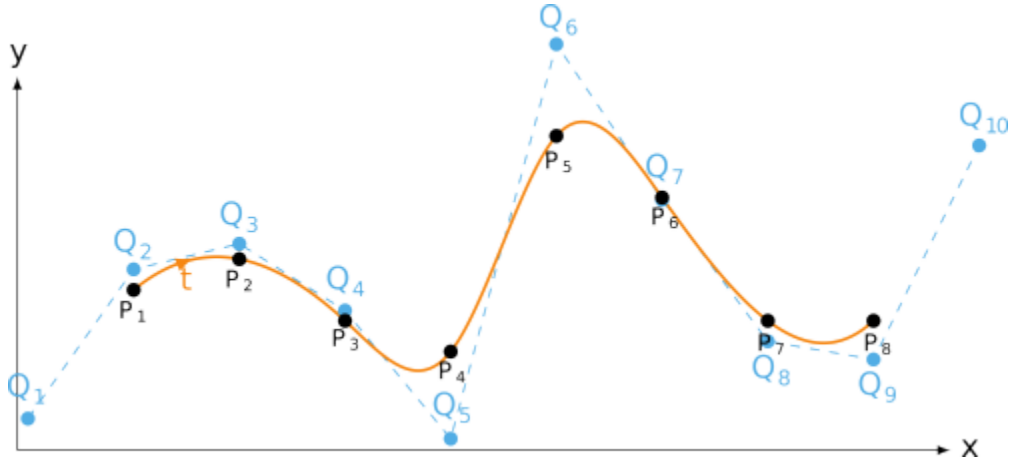
Python source code: end-to-end tangent continuity



cubic spline interpolated on a set of fit knots with end-to-end tangent continuity

not-a-knot end condition

Python source code: not-a-knot end condition

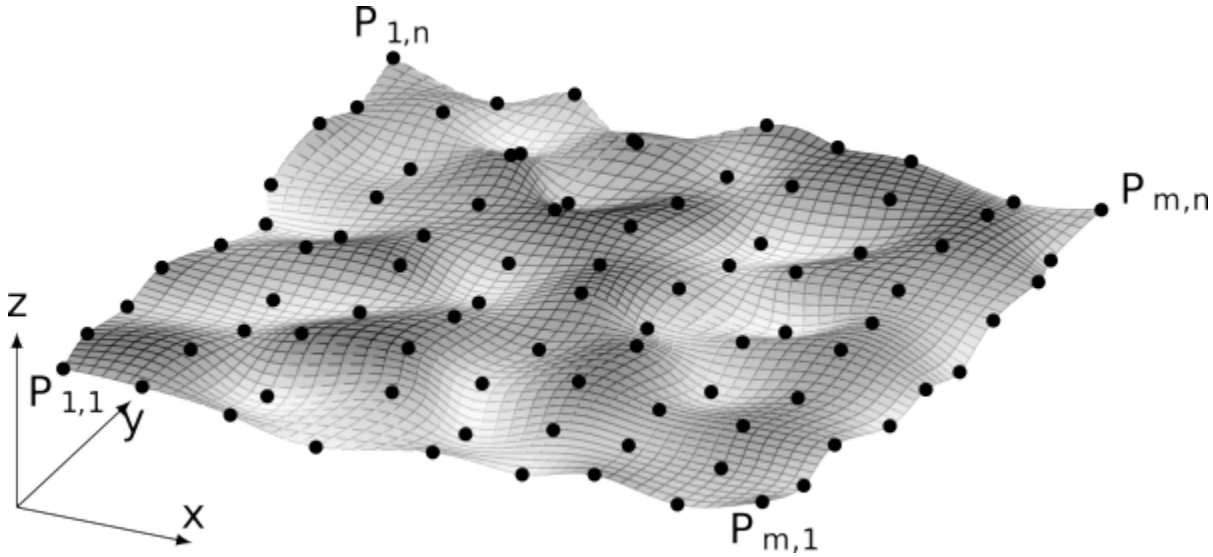


cubic spline interpolated on a set of fit knots with not-a-knot end conditions

3D bicubic parametric surface

free end condition

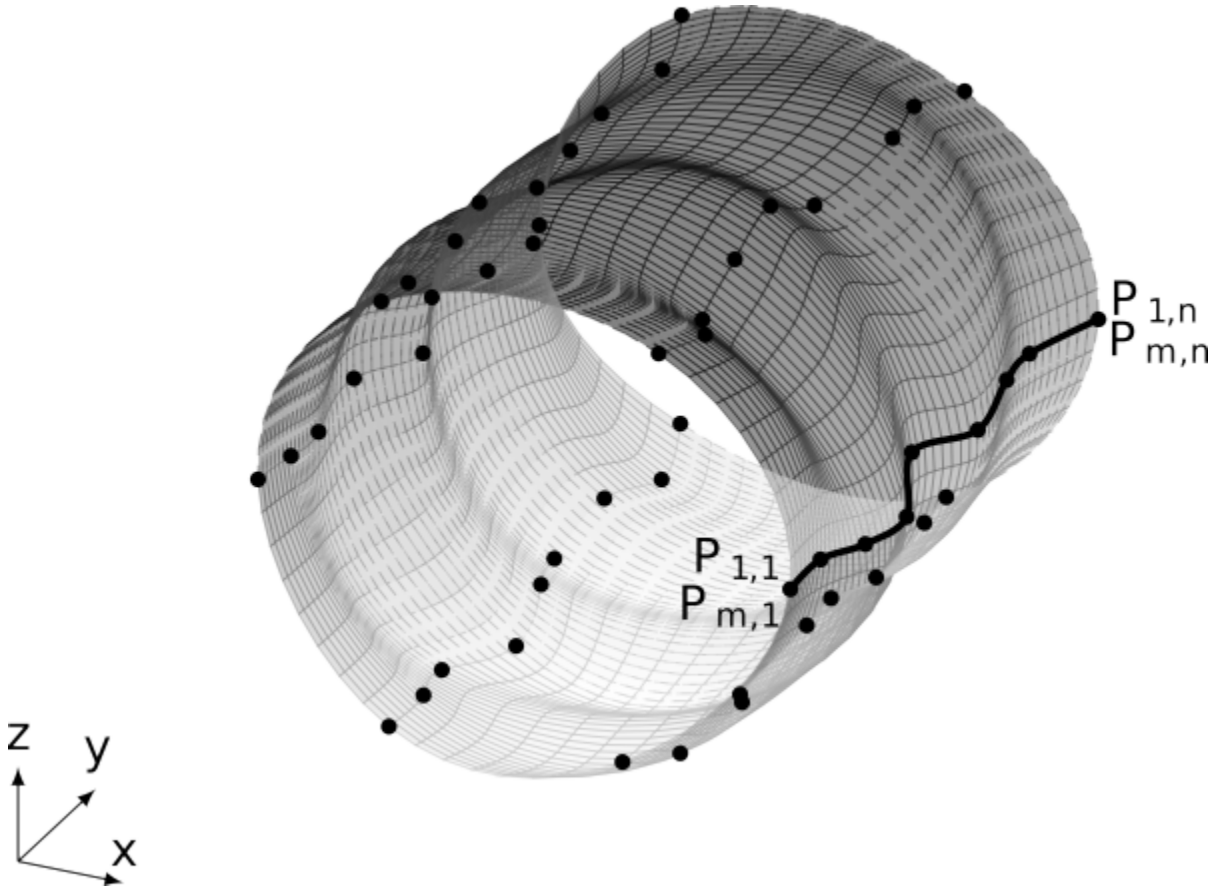
Python source code: free end condition



bicubic parametric surface interpolated on a set of fit knots with free end conditions

cylindrical closed surface

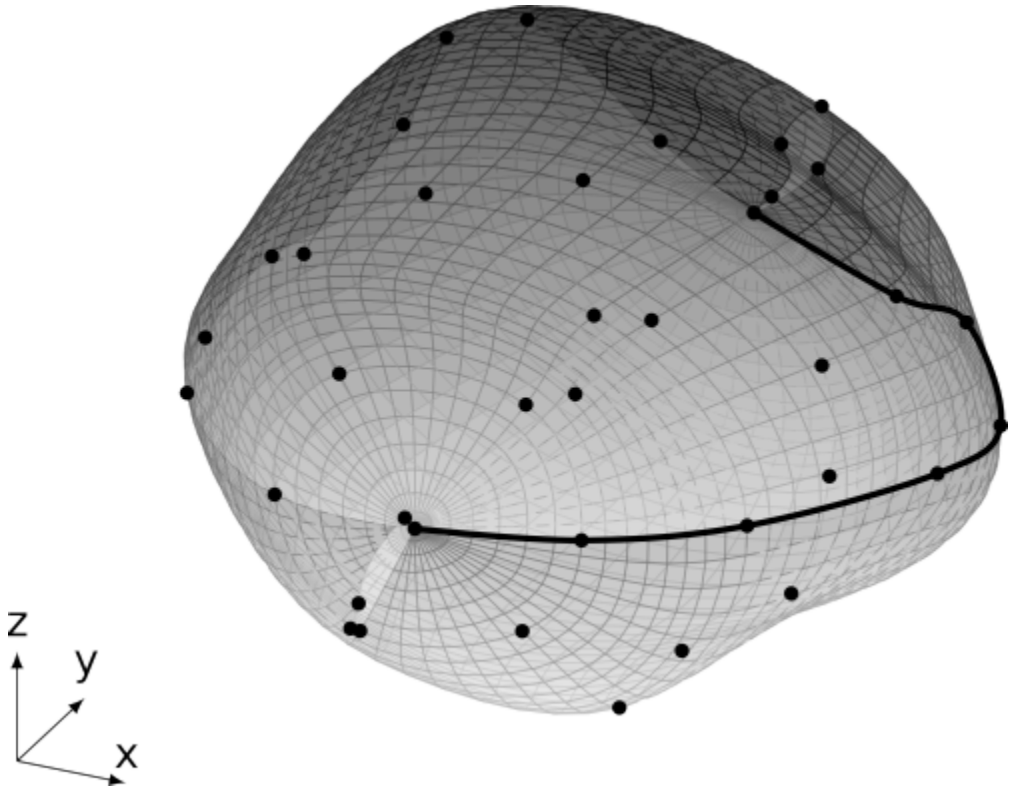
Python source code: cylindrical closed surface



closed bicubic parametric surface interpolated on a randomized cylindrical set of fit knots

spherical closed surface

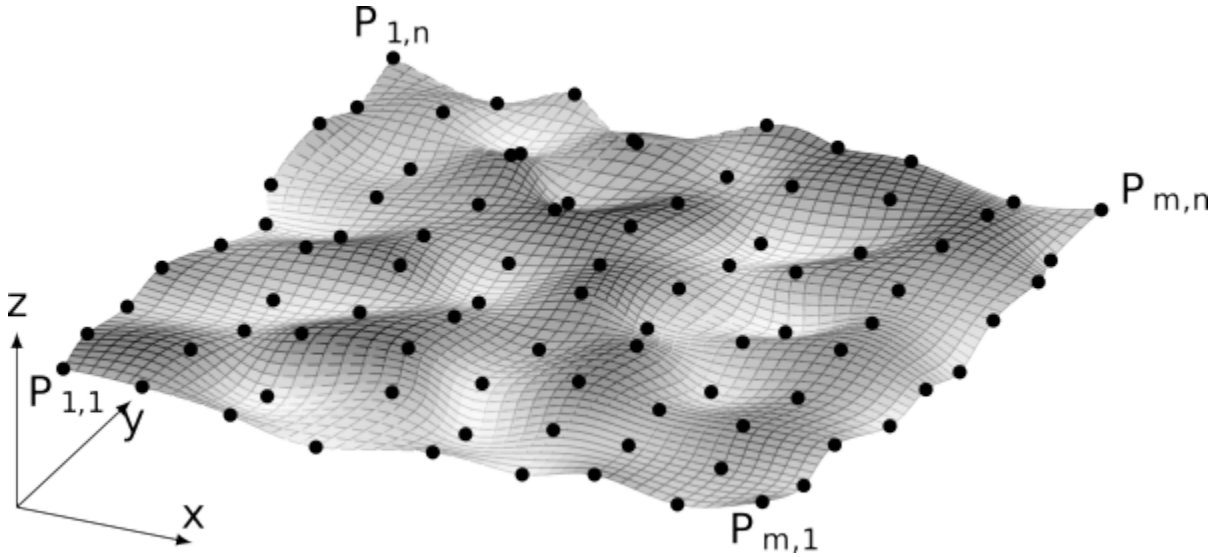
Python source code: spherical closed surface



fully closed bicubic parametric surface interpolated on a randomized spherical set of fit knots

not-a-knot end condition

Python source code: not-a-knot end condition



bicubic parametric surface interpolated on a set of fit knots with not-a-knot end conditions

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