# Multi-sided surfaces interpolating arbitrary boundaries with intuitive interior control

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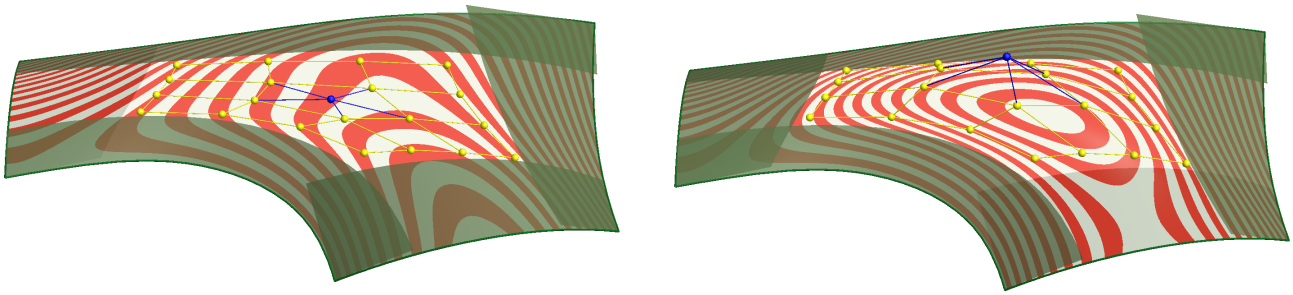
The representation of multi-sided (non-quadrilateral) surfaces is an interesting and difficult problem of computer-aided geometric design. The *de facto* standard solution in commercial systems is *trimming*, where the patch is defined by clipping the domain of a larger four-sided surface. This approach has several drawbacks. The larger surface is often underdetermined, and the connection to adjacent patches is generally not even exactly $C^0$-continuous. Another popular choice is to subdivide the multi-sided region into quadrilaterals, but determining the subdivision curves is a delicate matter, and this method may also harm internal continuity.

There is a line of research promoting the use of non-standard representations that ensure smooth connections to adjacent patches. This comes basically in two flavors:

- *Transfinite surface interpolation.* The surfaces are more-or-less completely defined by the boundary constraints, which are given in a very general form. Some types of interior control, such as snapping to auxiliary objects or a base surface, were attempted before (see e.g. [4, 1]), but these are not really suitable for an interactive design process.
- *Control-point–based approaches.* Representations such as the generalized Bézier patch [3], in addition to adhering to the boundary constraints, also offer a very intuitive control of the interior, but they are usually restricted to having (rational) polynomial boundaries. The recent generalized B-spline patch [2] is an exception, but it lacks the connected control network of its predecessor.

In this work I have attempted to combine these two worlds. The result—unlike [1]—is not CAD-exportable, and—unlike [2]—it cannot handle the multiply connected and/or concave, extreme configurations. What it does offer, on the other hand, is accurate interpolation of arbitrary boundaries *as well as* a natural control of the surface interior, suitable for interactive editing or approximation, while retaining the ability to smoothly connect to adjacent patches.



## References

[1] F. Martin, U. Reif. Trimmed spline surfaces with accurate boundary control. *arXiv preprint*, 2009.02480v2, 2021.

[2] M. Vaitkus, T. Várady, P. Salvi, Á. Sipos. Multi-sided B-spline surfaces over curved, multi-connected domains. *Computer Aided Geometric Design*, 89:102019, 2021.

[3] T. Várady, P. Salvi, Gy. Karikó. A multi-sided Bézier patch with a simple control structure. *Computer Graphics Forum*, 35(2):307–317, 2016.

[4] T. Várady, P. Salvi, A. Rockwood. Transfinite surface interpolation with interior control. *Graphical Models*, 74(6):311–320, 2012.