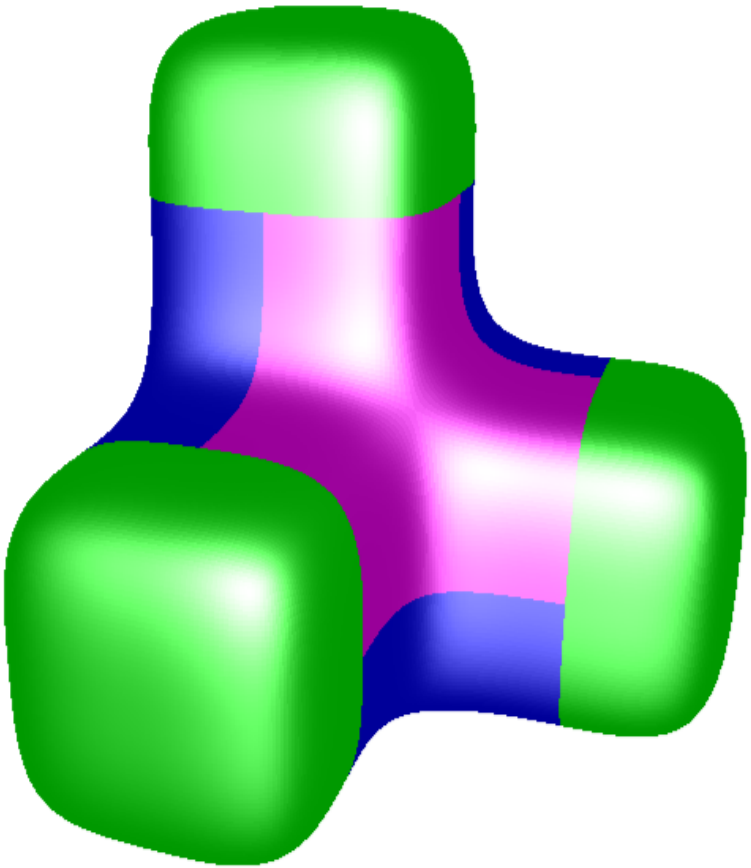
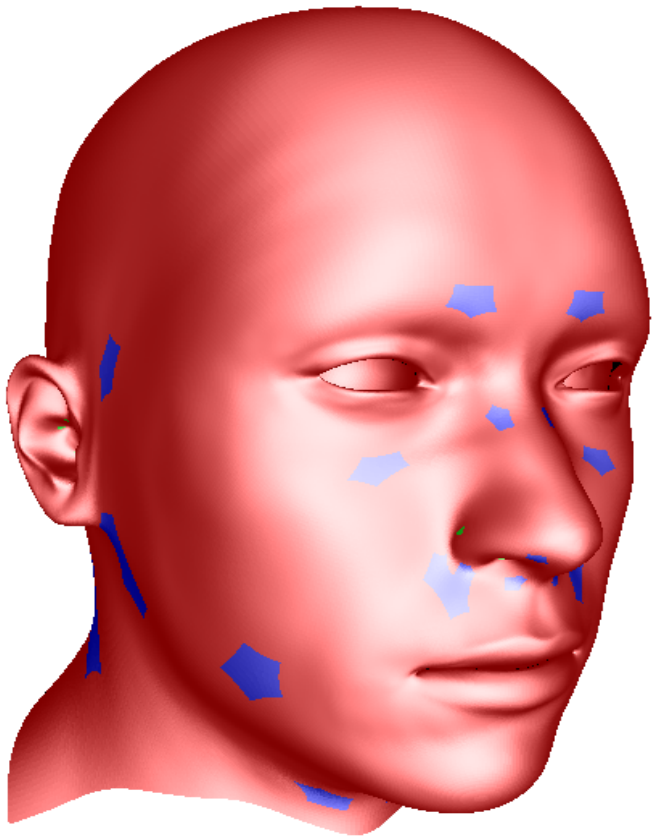
Laboratoire Électronique Informatique et Image

Barycentric Combinations Based Subdivision Surfaces





UBFC
UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

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LE2I - University of Burgundy, Dijon
Wednesday, 30 May 2018

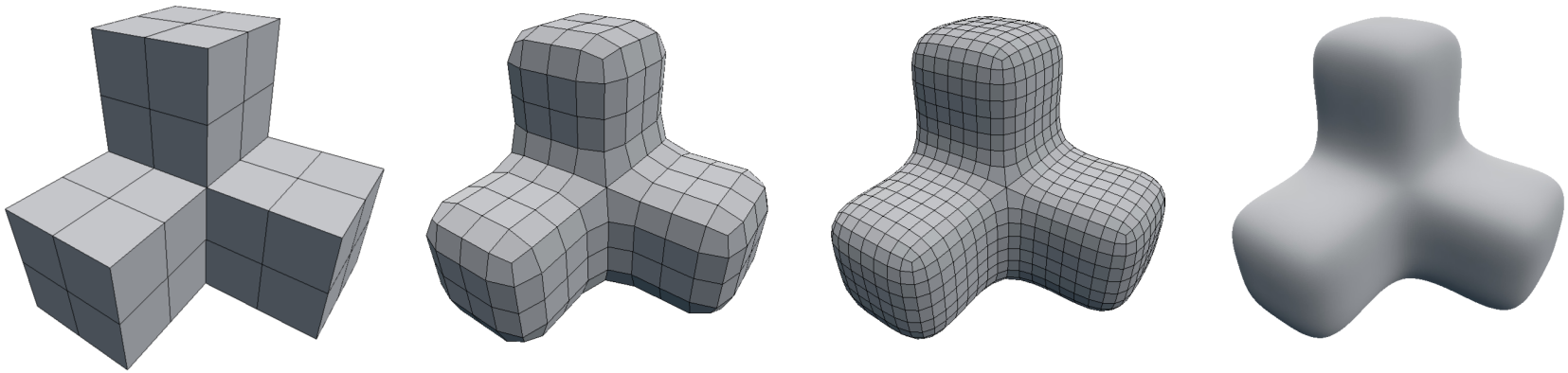
1 Introduction

2 Catmull-Clark scheme

3 Other subdivision schemes

4 Conclusion

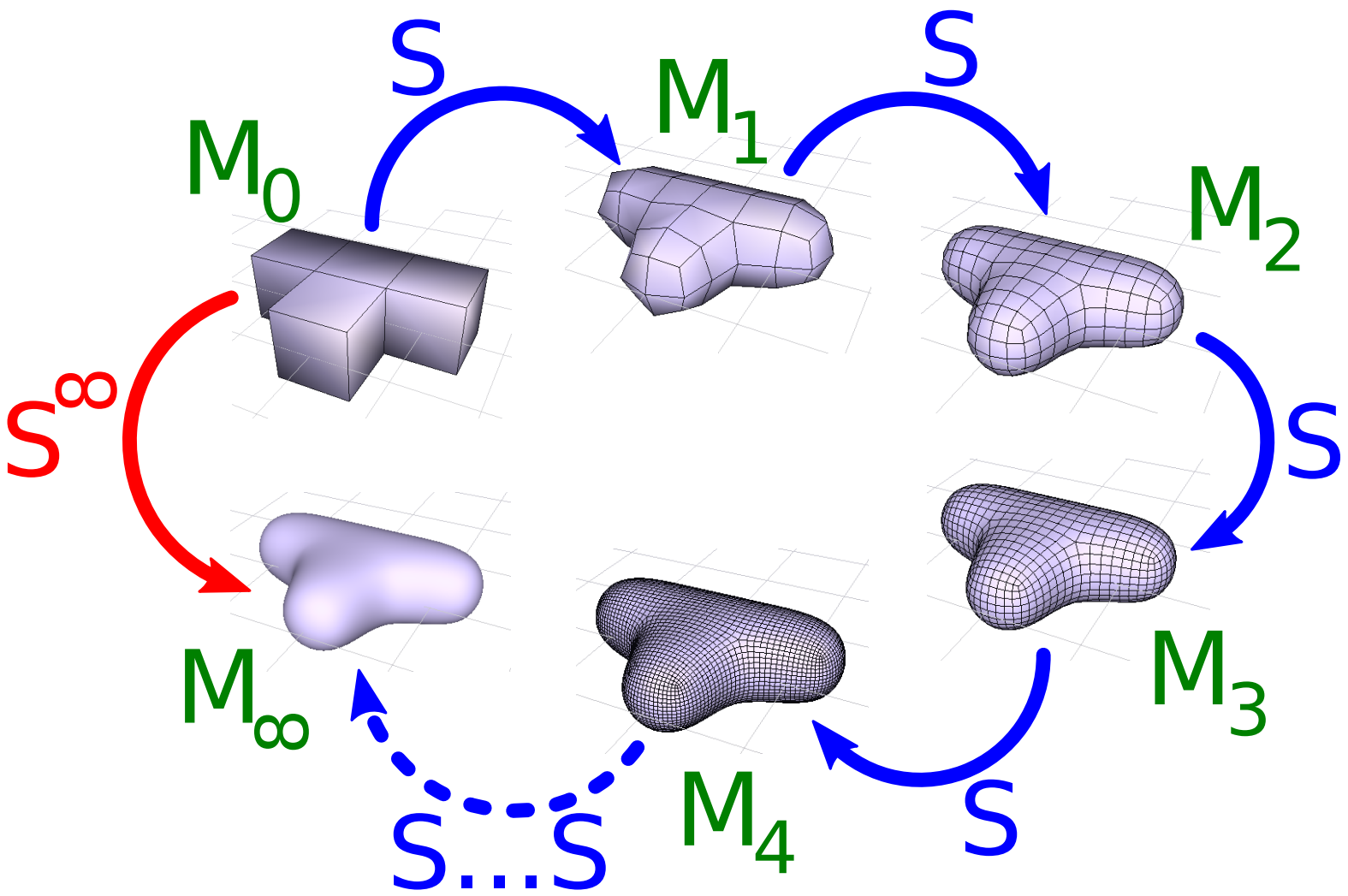
SUBDIVISION SURFACES



Definitions

- A subdivision scheme is a set of rules which transforms a mesh to a finer one
- The control mesh is the first and the coarsest one
- A subdivision surface is obtained by applying few times and iteratively a subdivision scheme on the control mesh

LIMIT SURFACE



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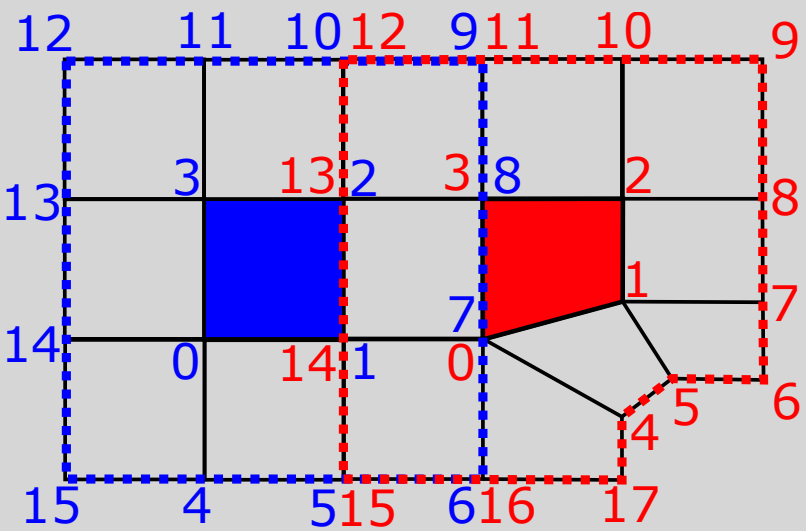
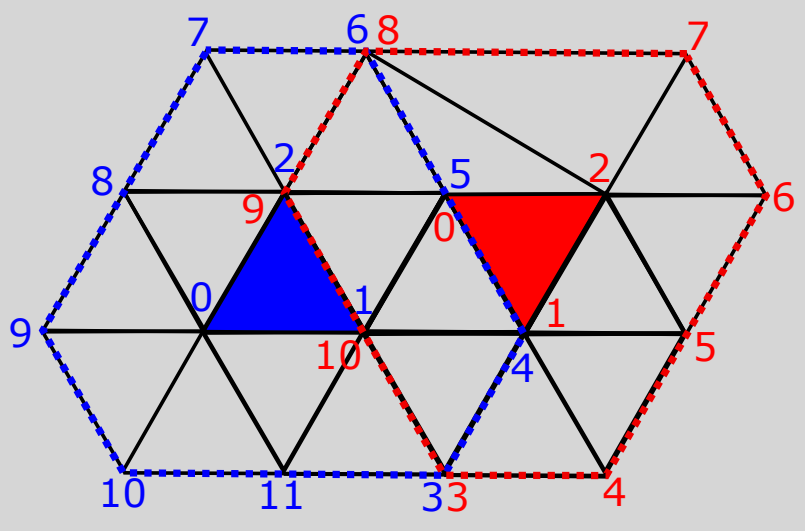
HOW TO CONSTRUCT PATCHES FROM A MESH

A patch is set of vertices connected by edges which is necessary and sufficient to compute a piece of the limit surface

Catmull-Clark scheme



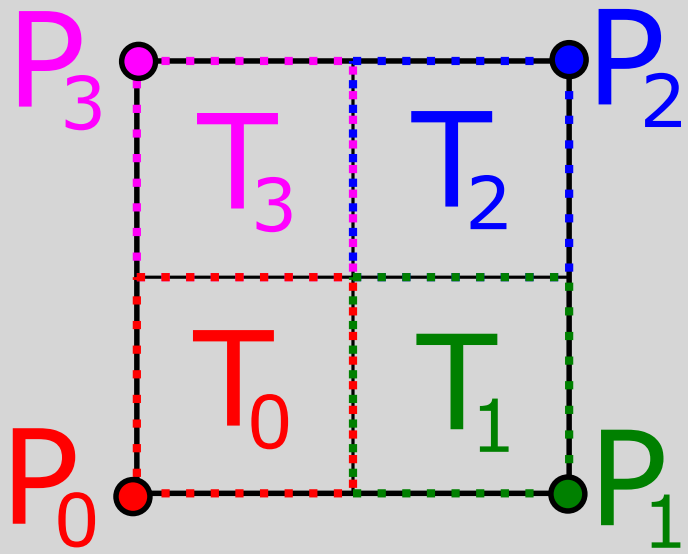
Loop scheme



pas plus d'une irrégularité par patch ! !

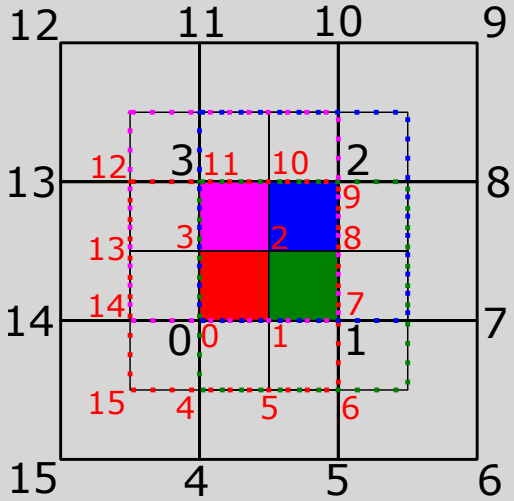
EQUIVALENCE BETWEEN PARAMETRIC AND BARYCENTRIC SPACES

Parametric space



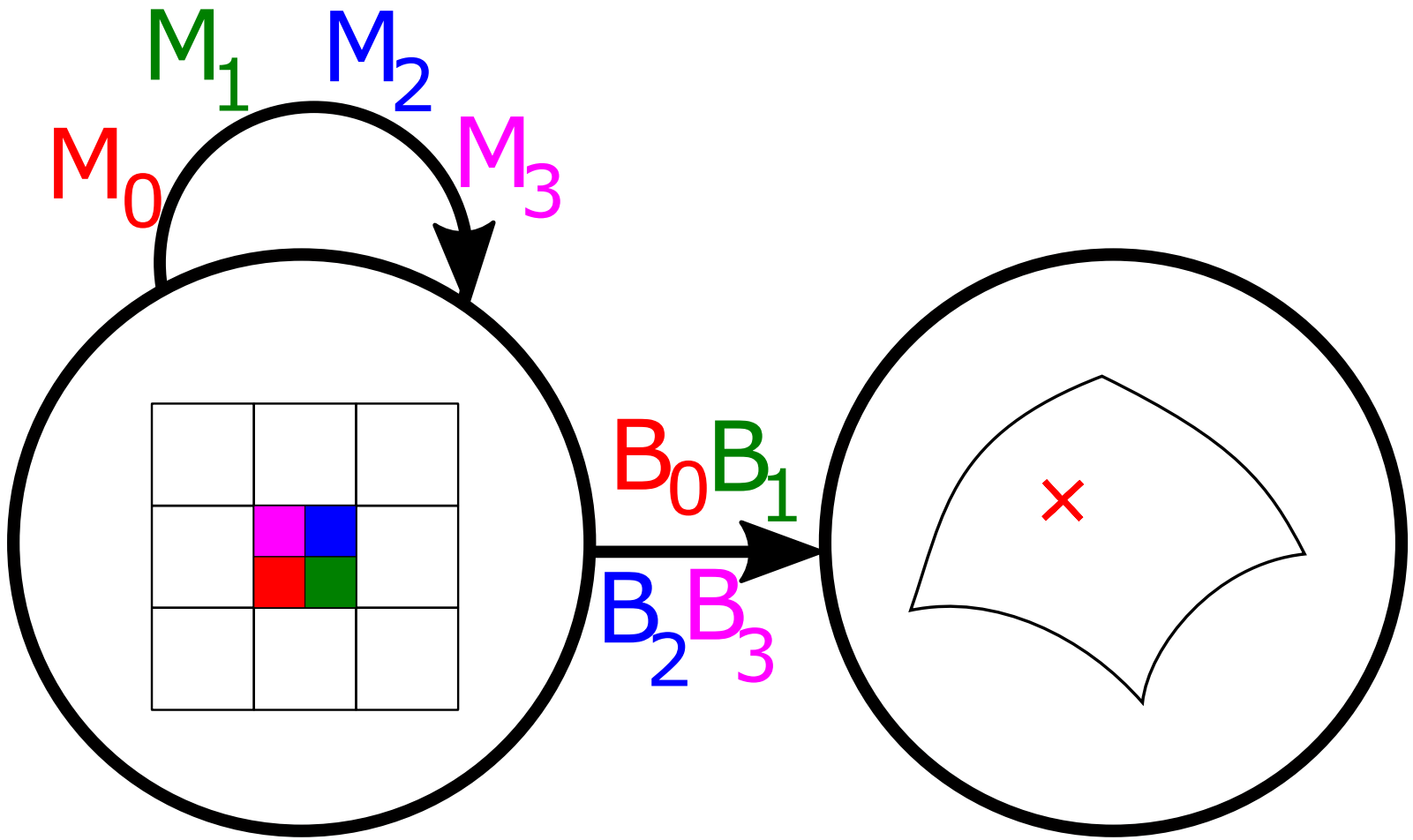
- Every T_i associates the unit square to itself
- Every $P_i = T_i^\infty$ associates the unit square to one of its corner

Barycentric space

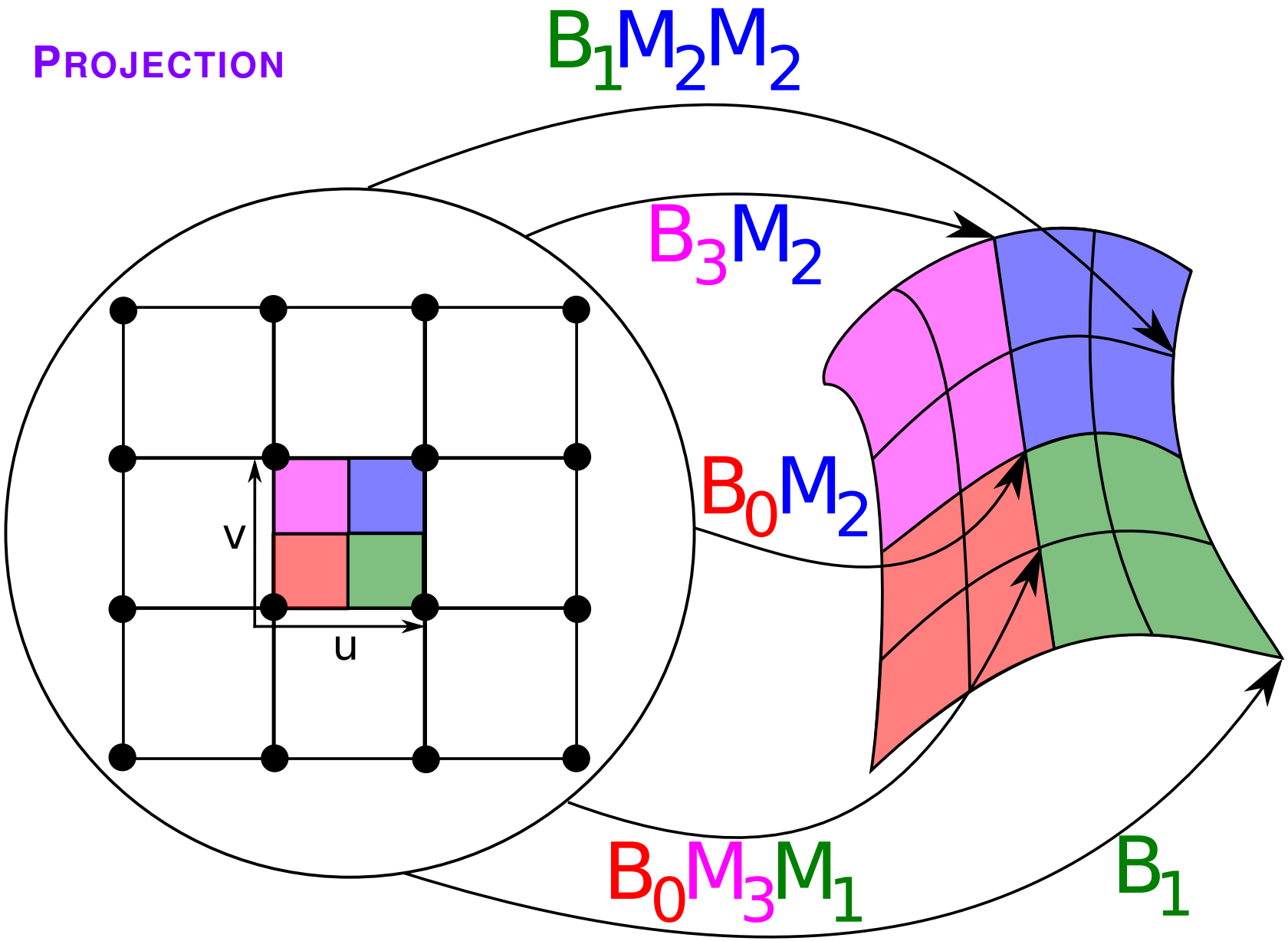


- Every M_i associates a patch to one of its subpatches
- Every $B_i \approx M_i^\infty$ associates a patch to a point of limit surface

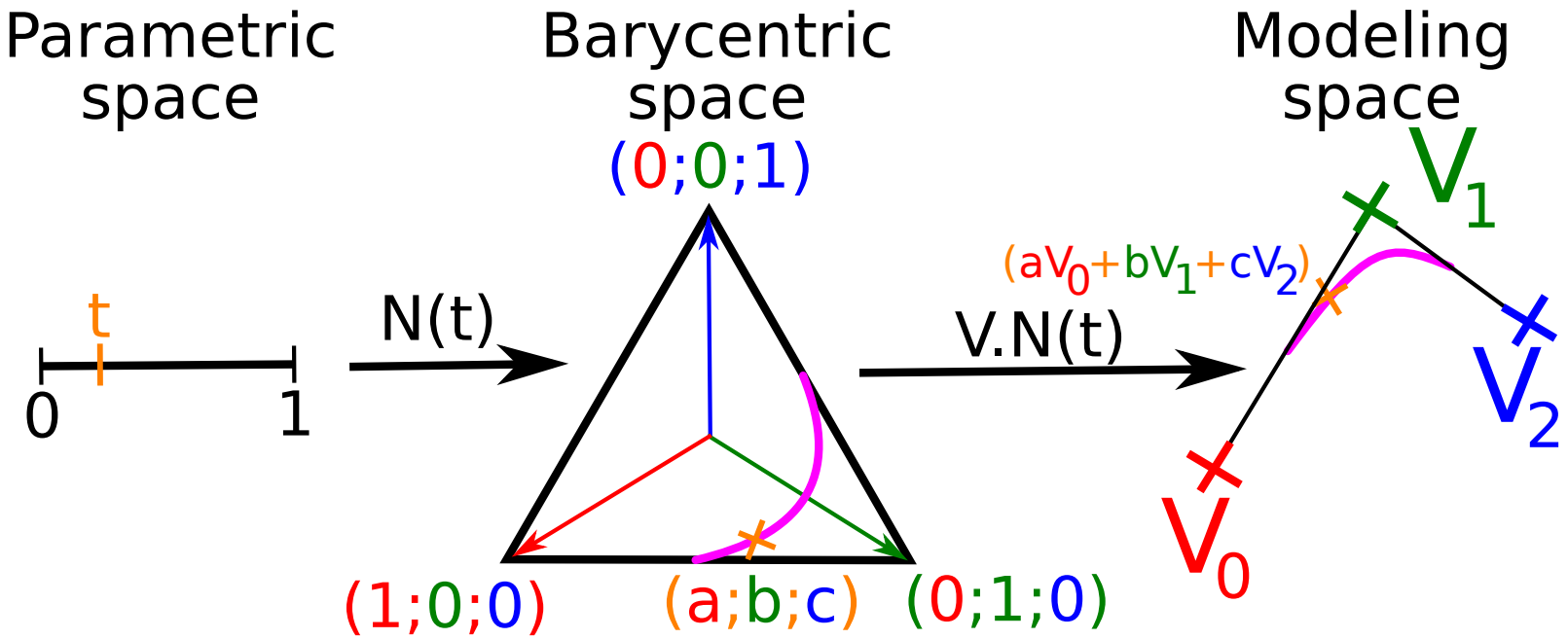
REGULAR CONTROLLED ITERATED FUNCTION SYSTEM AUTOMATON



PROJECTION

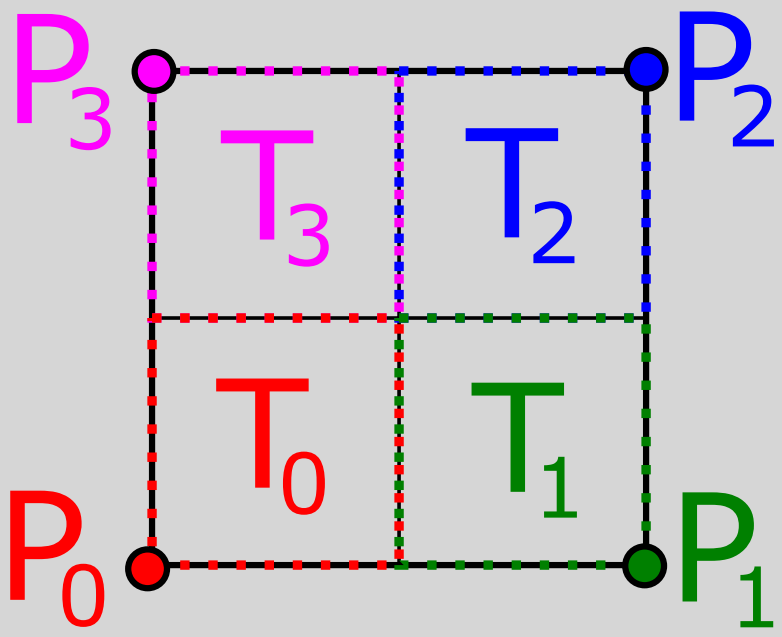


OVERVIEW


Parametric space
Barycentric space
Modeling space
(0;0;1)
t
0
1
N(t)
V.N(t)
(aV0+bV1+cV2)
V1
V2
V0
(1;0;0)
(a;b;c)
(0;1;0)

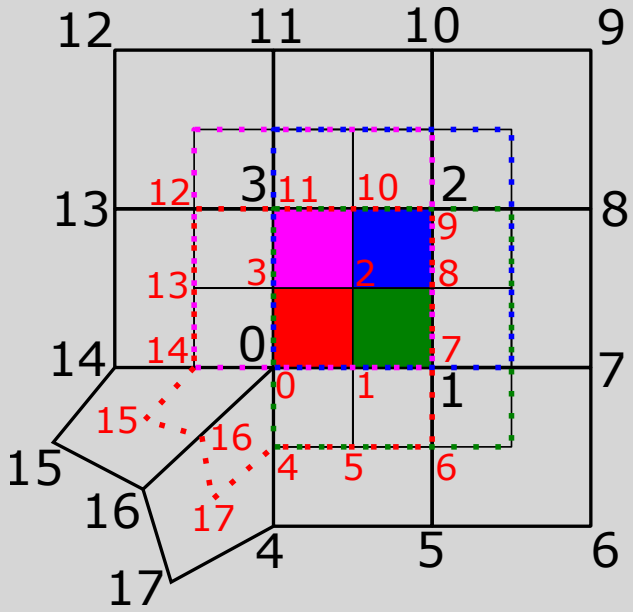
EXTRAORDINARY CASE

Parametric space



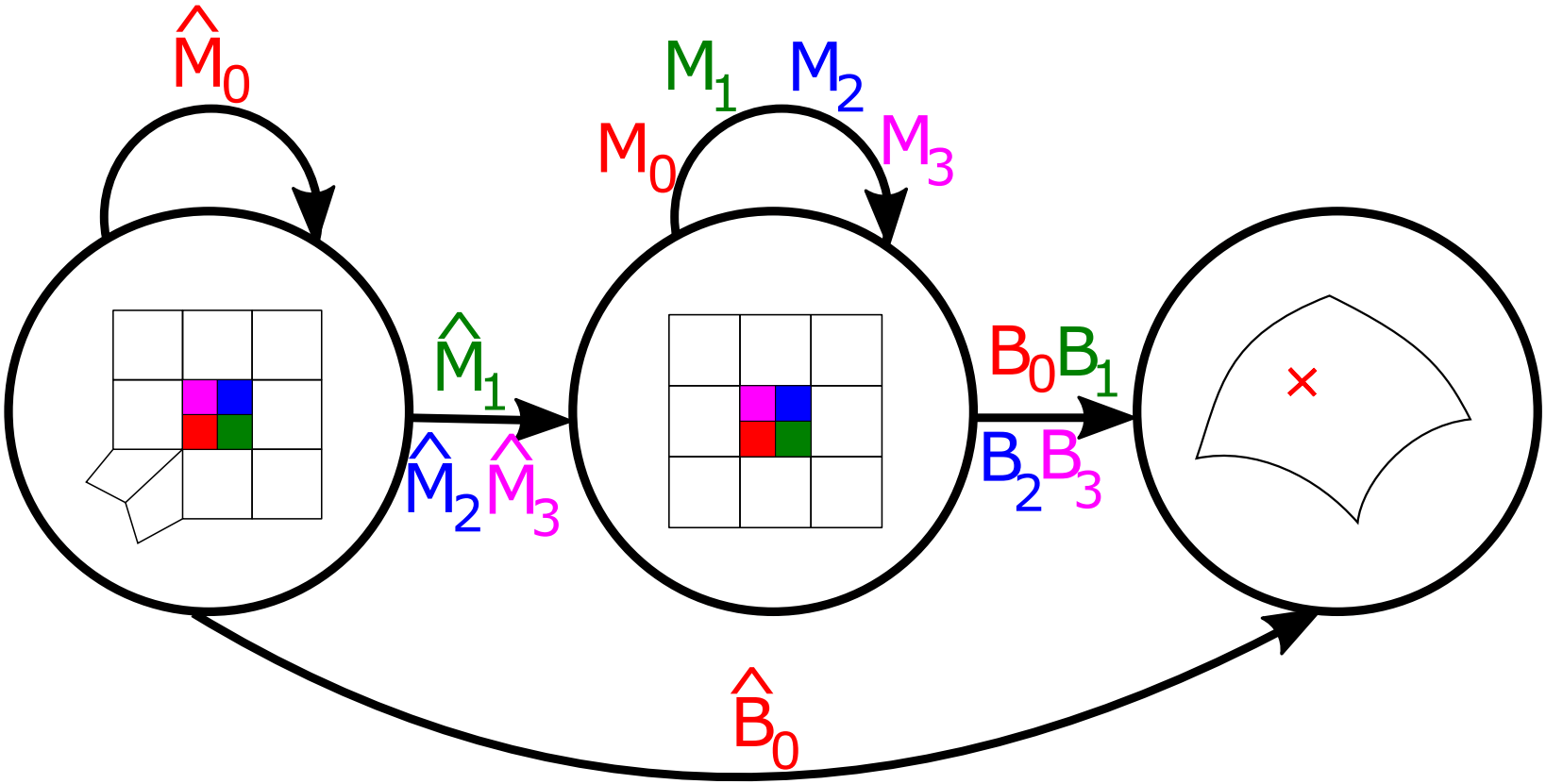
- Every T_i associates the unit square to itself

Barycentric space



- Every $\hat{M}_i$ associates a patch to one of its subpatches

EXTRAORDINARY AUTOMATON



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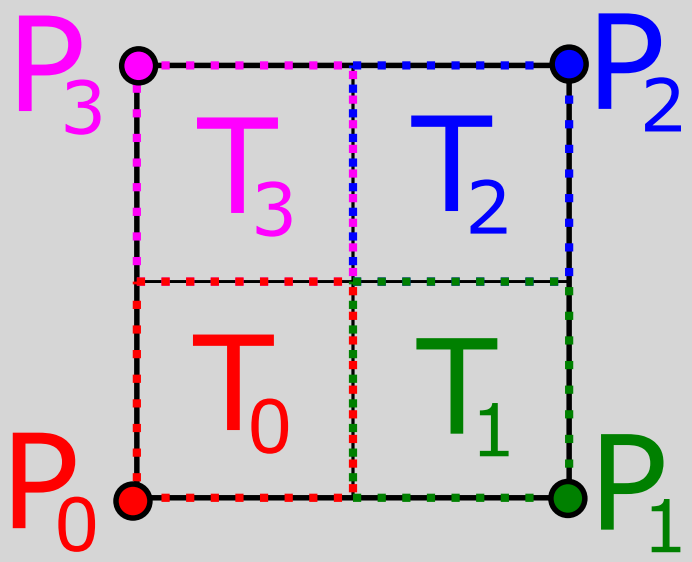
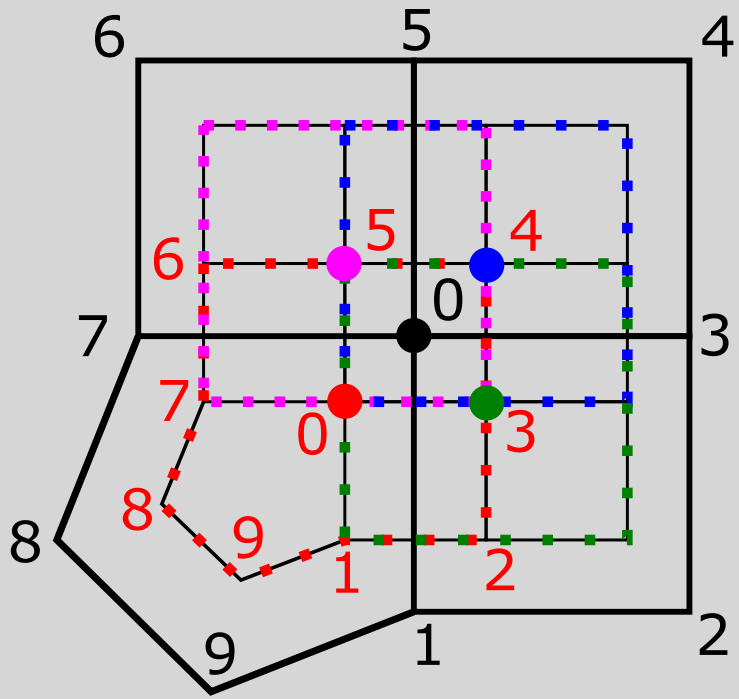
DOO-SABIN SCHEME

Parametric Space

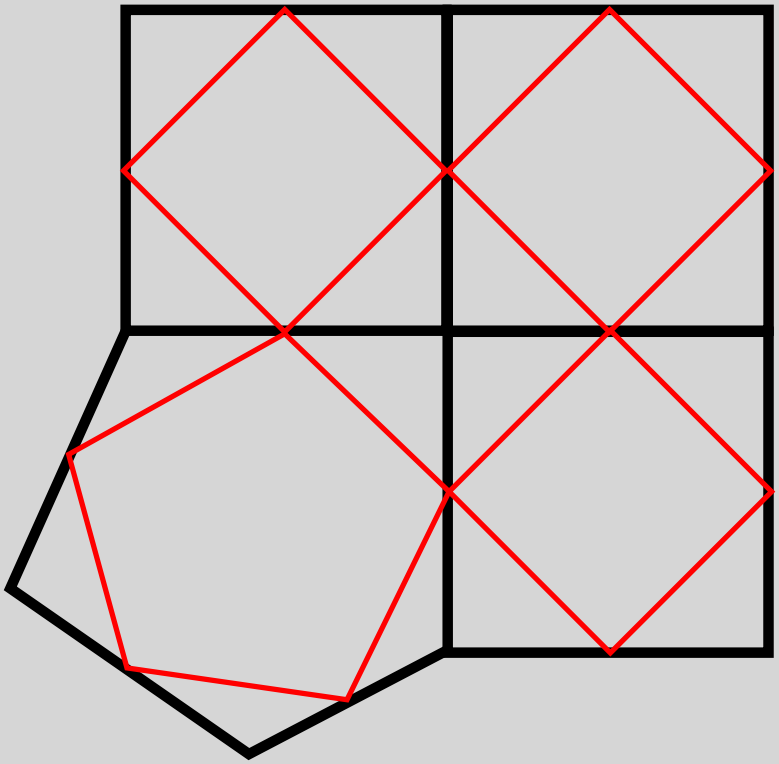


Barycentric Space

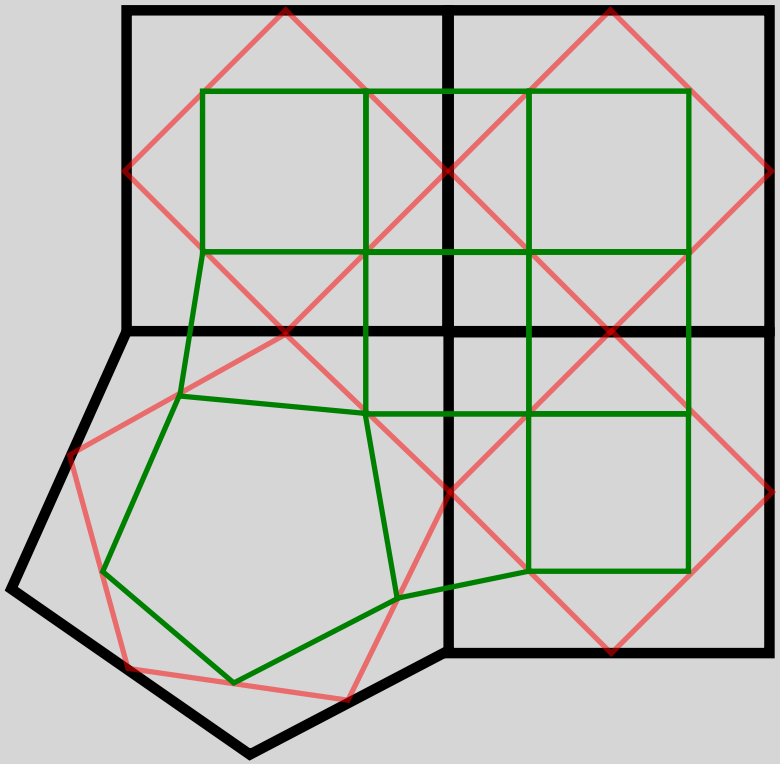


SIMPLEST (MID-EDGE) SCHEME

First step

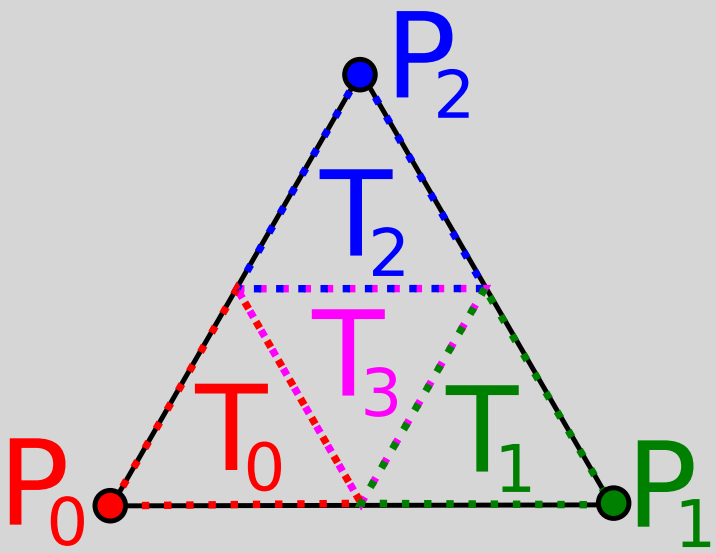


Second step

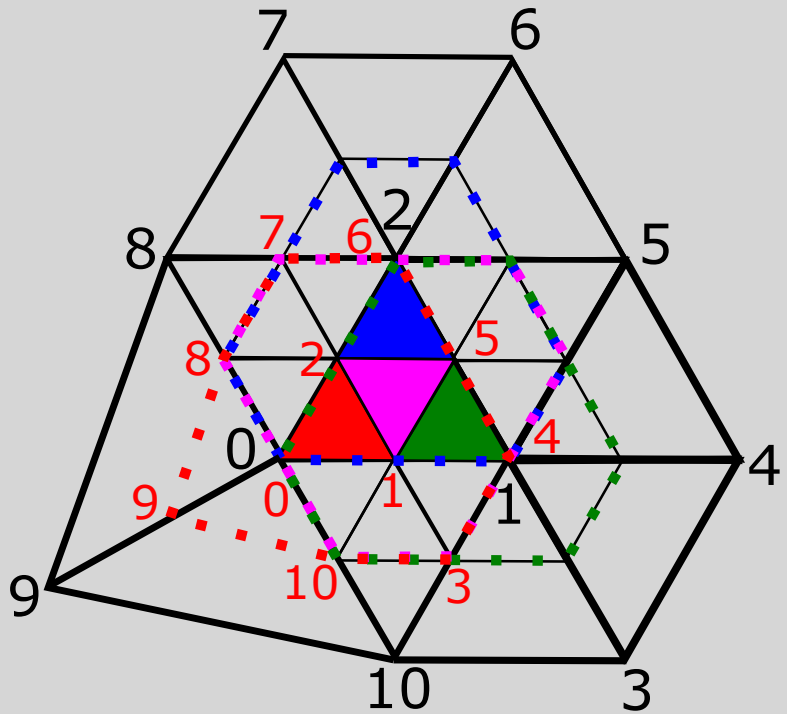


LOOP SCHEME

Parametric space



Barycentric space



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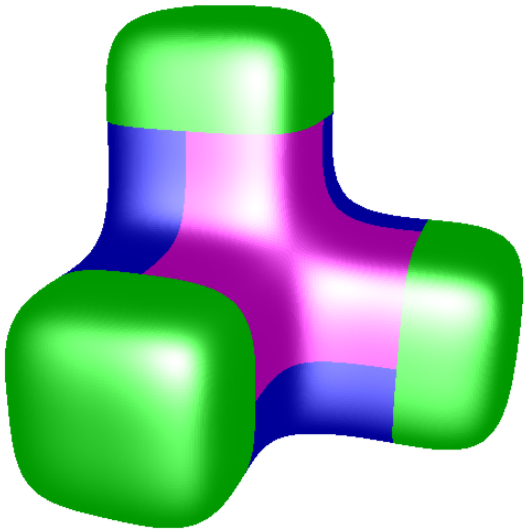
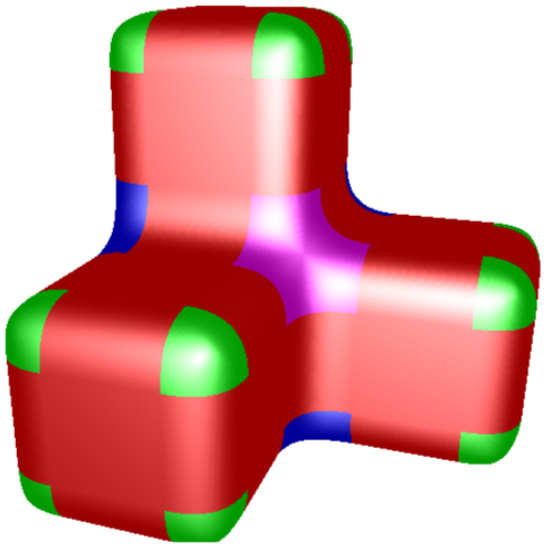
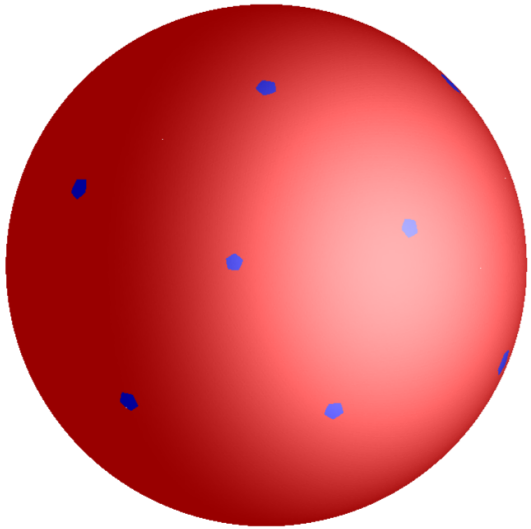
RESULTS







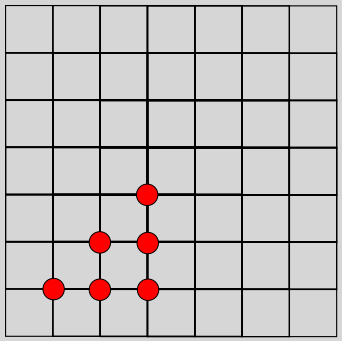
CONCLUSION, LIMITS, AND FUTURE WORKS

Conclusion

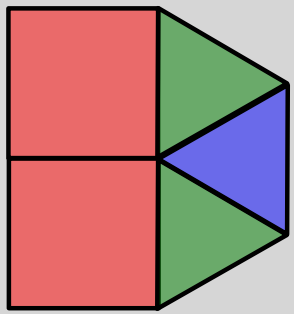
Our method :

- splits parametric, barycentric, and modeling spaces which are usually blend in the subdivision rules
- can handle every uniform subdivision scheme

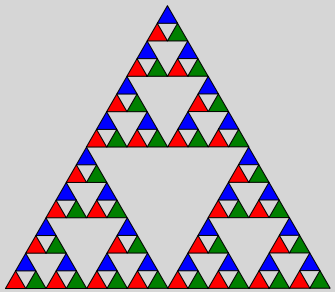
Future works



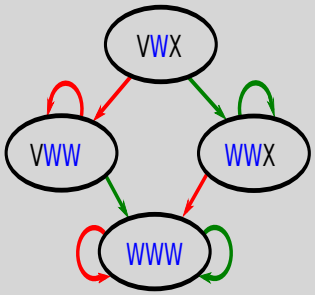
High-degree



Hybrid



Fractals



NURBS

MAIN REFERENCES

- 1988, Barnsley : Fractals everywhere
- 1993, Halstead : Efficient, Fair Interpolation using Catmull-Clark Surfaces
- 1998, Stam : Exact Evaluation of Catmull-Clark Subdivision Surfaces at Arbitrary Parameter Values

Thanks for your attention

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