Superficies de BSpline

Funciones

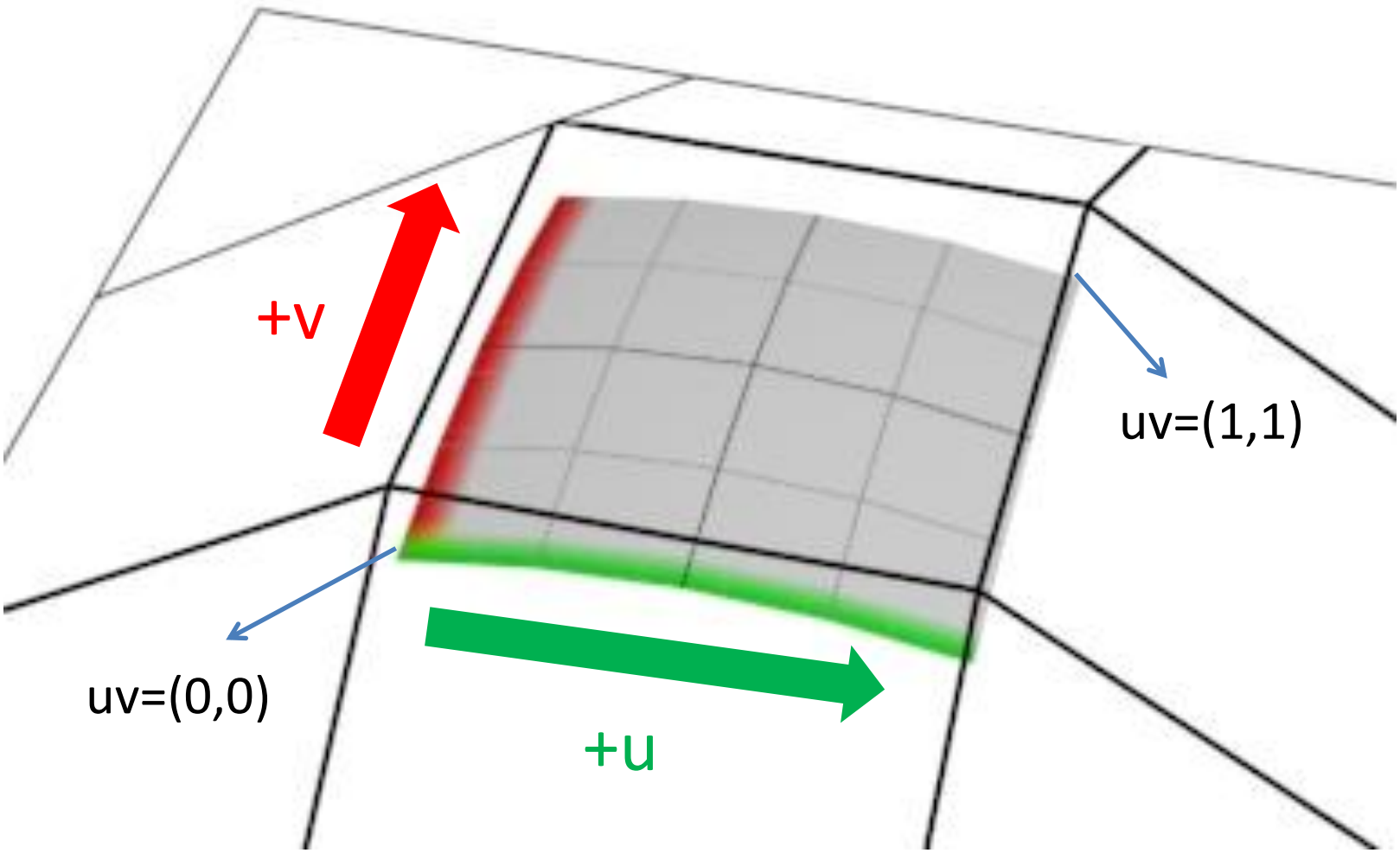
$$S_{k,l}(u,v) = \sum_{i=0}^{3} \sum_{j=0}^{3} b_j^3(v_k) b_i^3(u_l) P_{k+j,l+i}$$

u_l, v_k Son los parámetros locales del parche

b_j^3 Base B-Spline cúbica

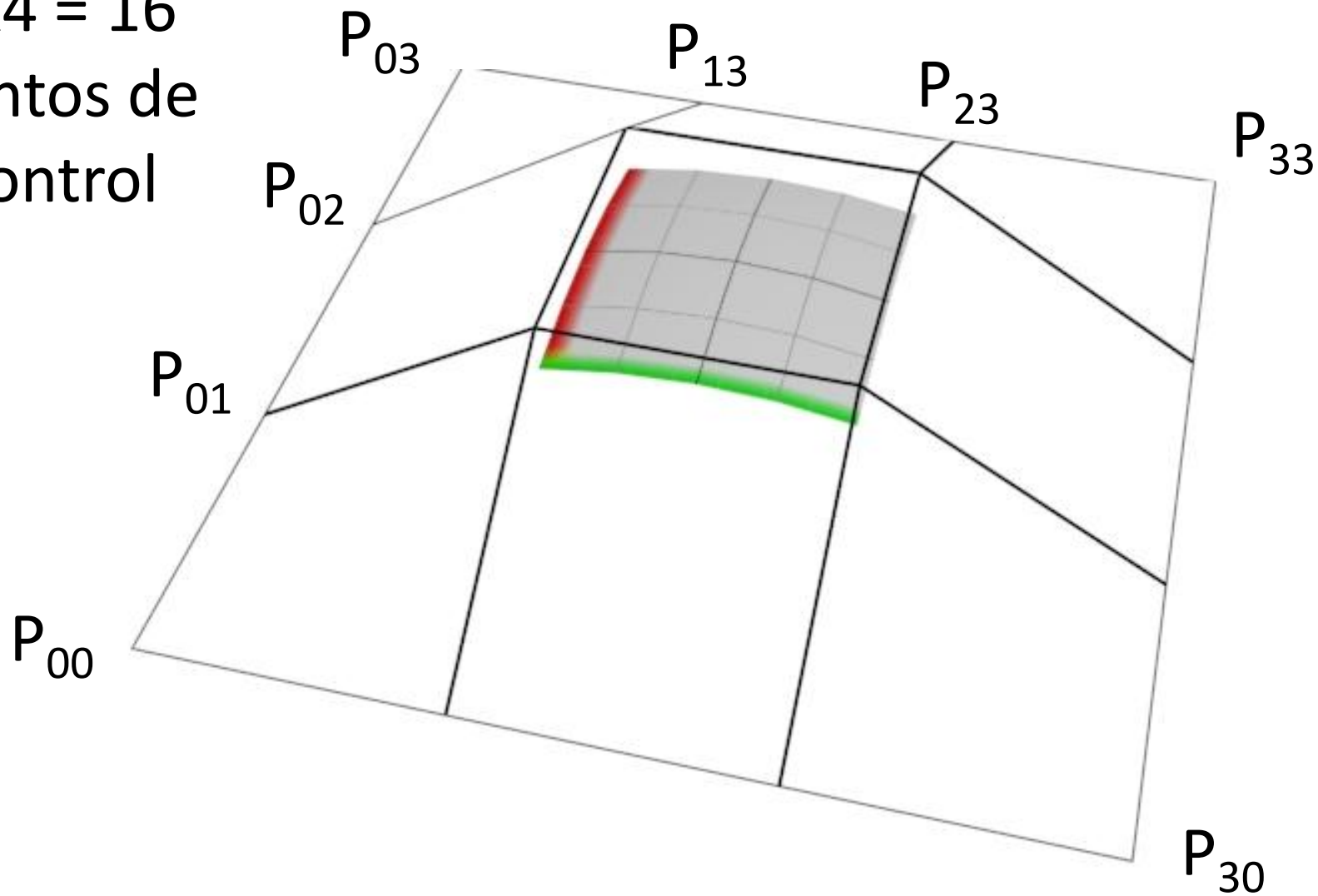
b_i^3 Base B-Spline cúbica

Parche BSpline



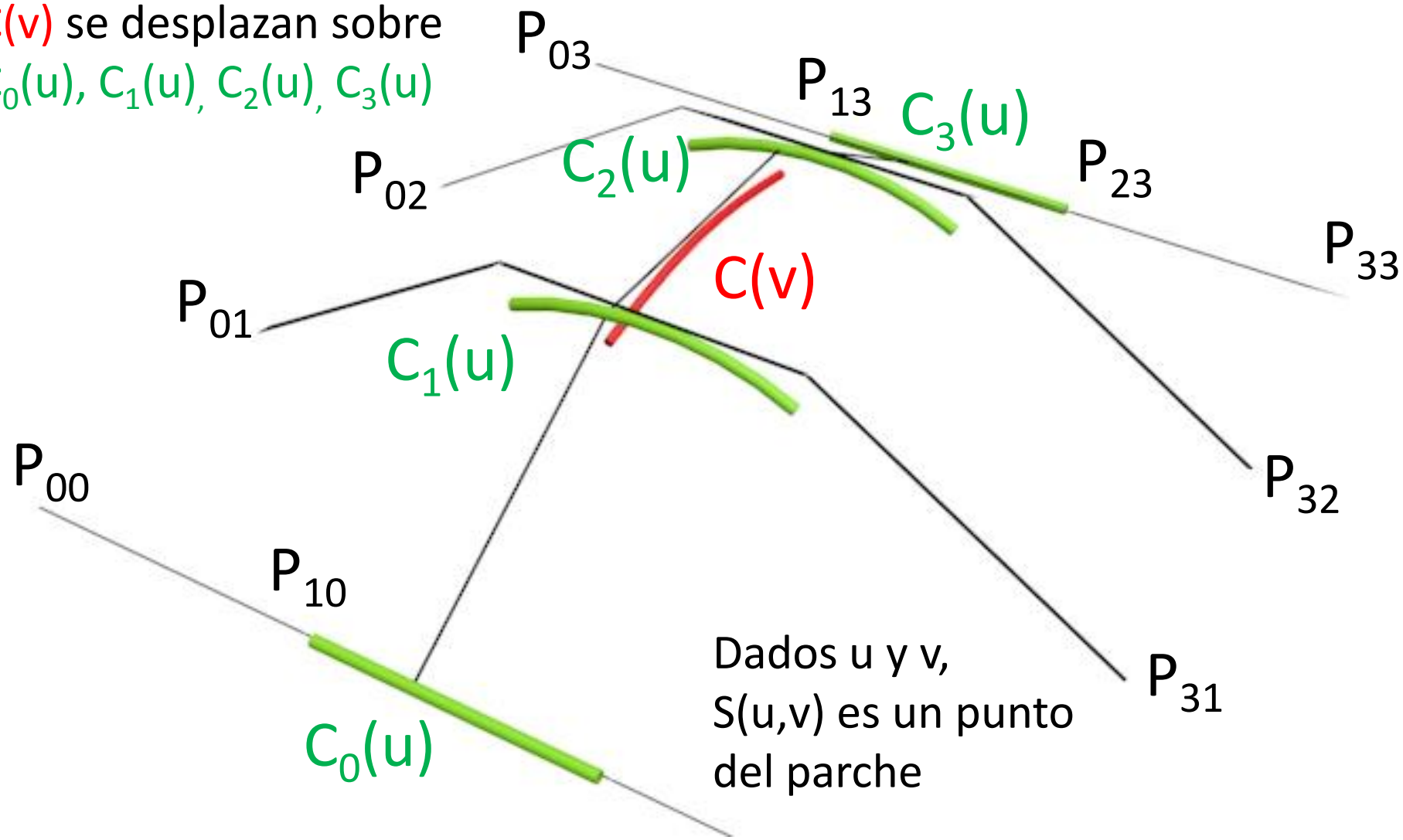
Parche B-Spline

4x4 = 16
Puntos de
control



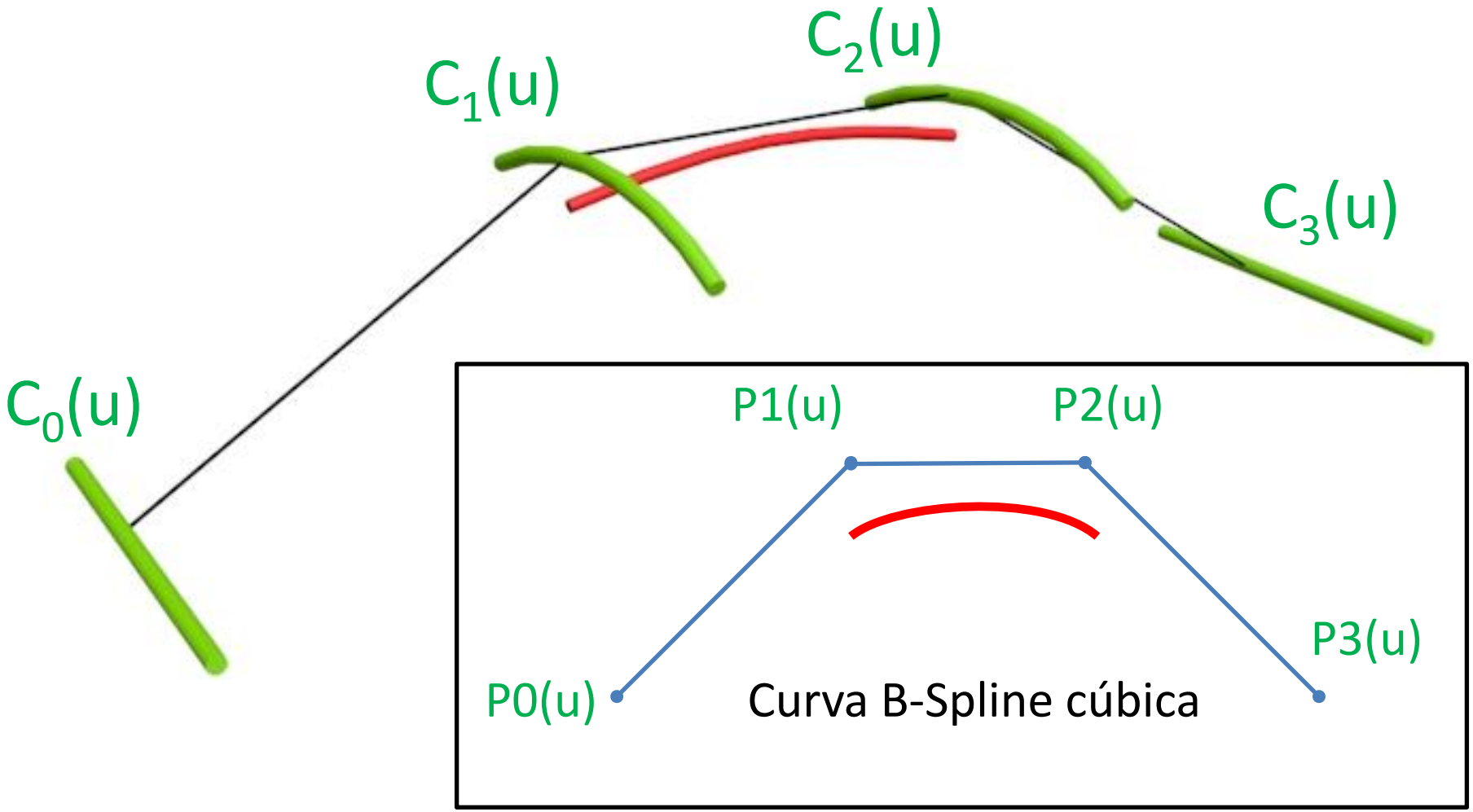
Contrucción del parche B-Spline

Los puntos de control de C(v) se desplazan sobre $C_0(u)$, $C_1(u)$, $C_2(u)$, $C_3(u)$



Dados u y v, S(u,v) es un punto del parche

Contrucción del parche B-Spline



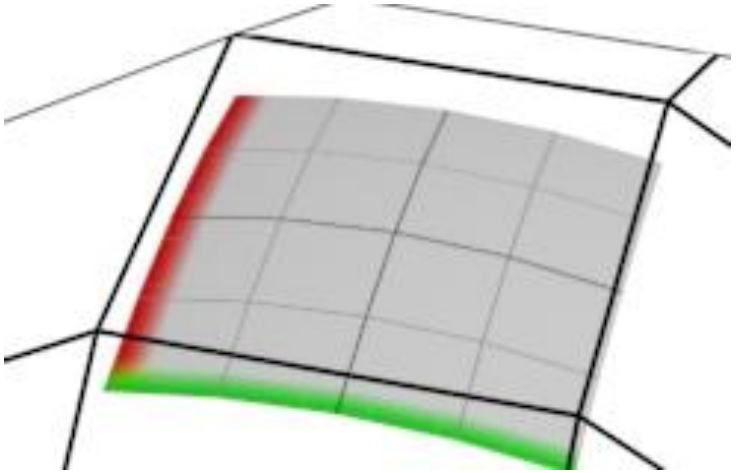
Expresión matricial

$B_{0(v)}, B_{1(v)}, B_{2(v)}, B_{3(v)}$

$S(u,v) =$ Vector4 x Vector4 x Matríz4x4

$B_{0(u)}, B_{1(u)}, B_{2(u)}, B_{3(u)}$

$$\begin{matrix} P_{00} & P_{01} & P_{02} & P_{03} \\ P_{10} & P_{11} & P_{12} & P_{13} \\ P_{20} & P_{21} & P_{22} & P_{23} \\ P_{30} & P_{31} & P_{32} & P_{33} \end{matrix}$$

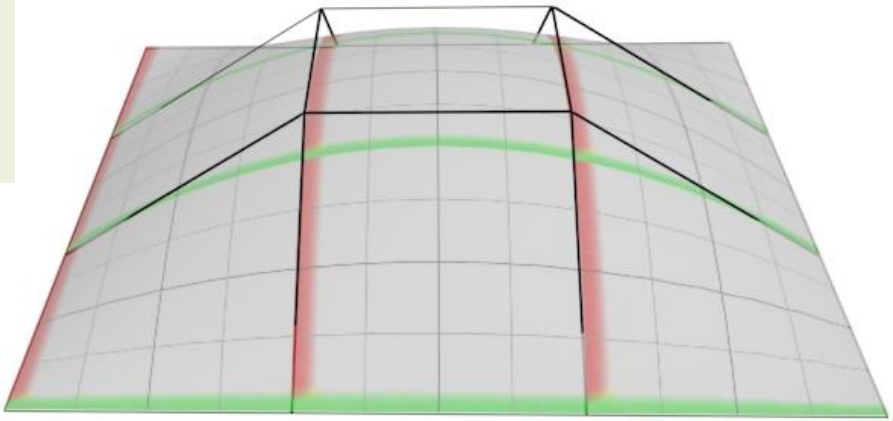


Superficies de múltiples parches

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

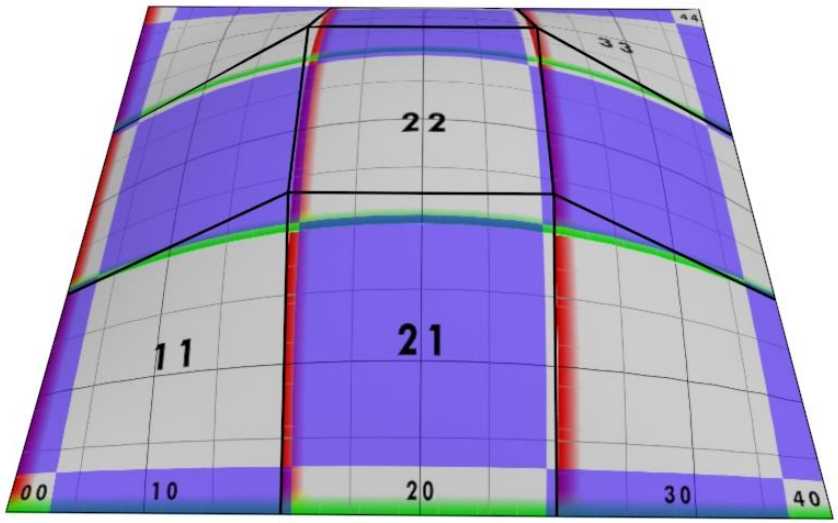
Se repiten puntos de control en los bordes y esquinas de la matríz

Forman 5x5 =25 parches individuales



Superficies de múltiples parches

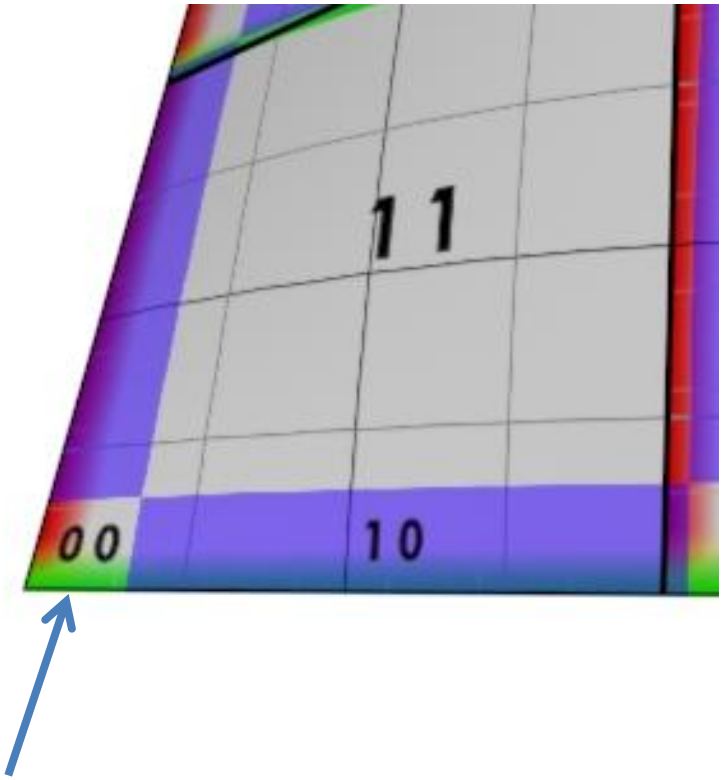
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}



Superficies de múltiples parches

Parche00

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

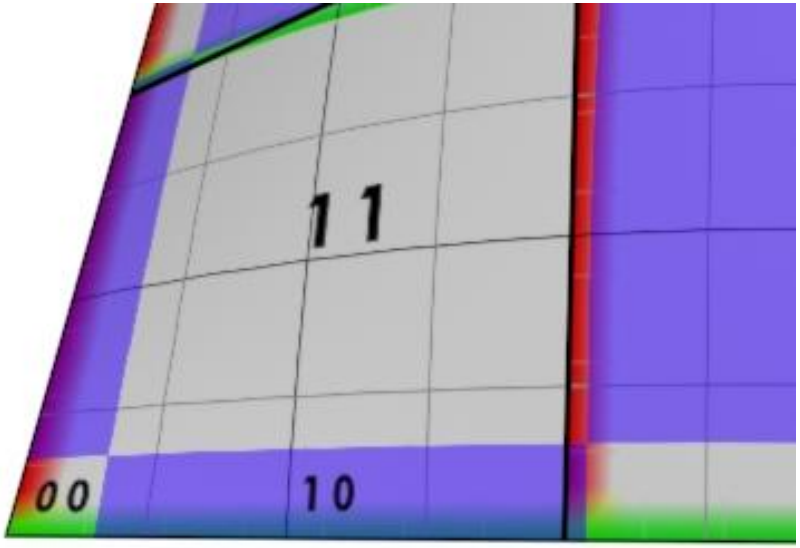


Parche00

Superficies de múltiples parches

Parche10

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

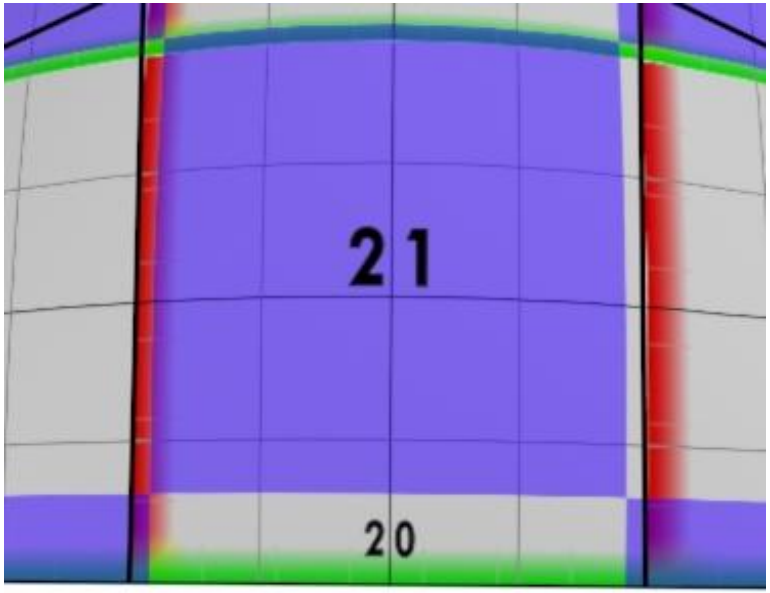


Parche10

Superficies de múltiples parches

Parche20

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

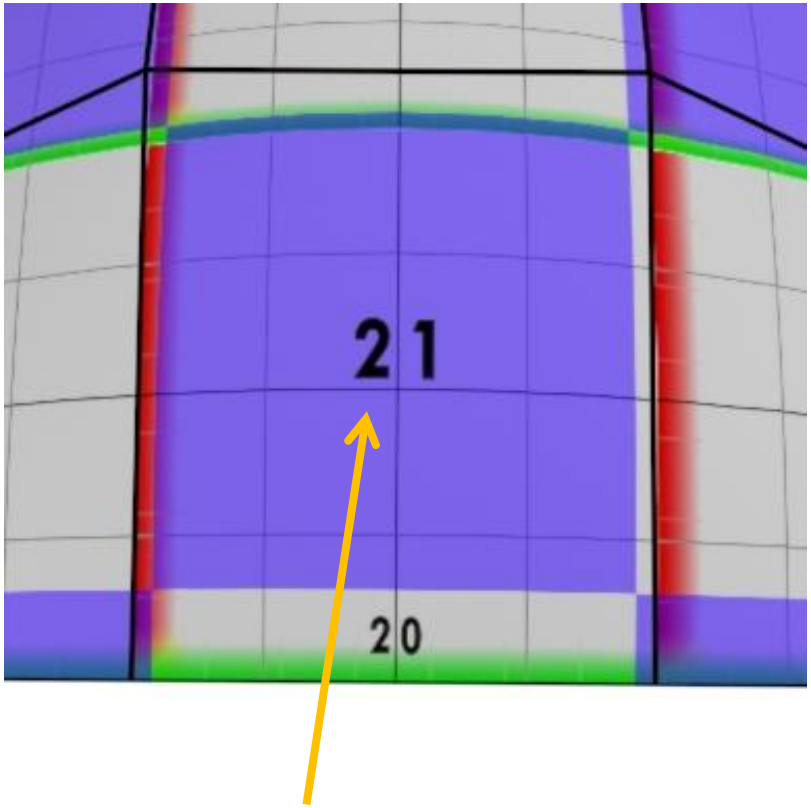


Parche20

Superficies de múltiples parches

Parche21

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

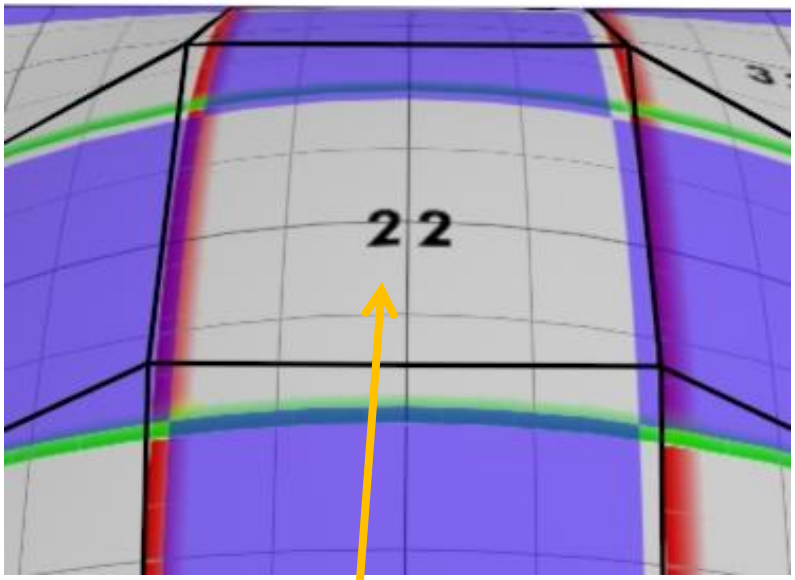


Parche21

Superficies de múltiples parches

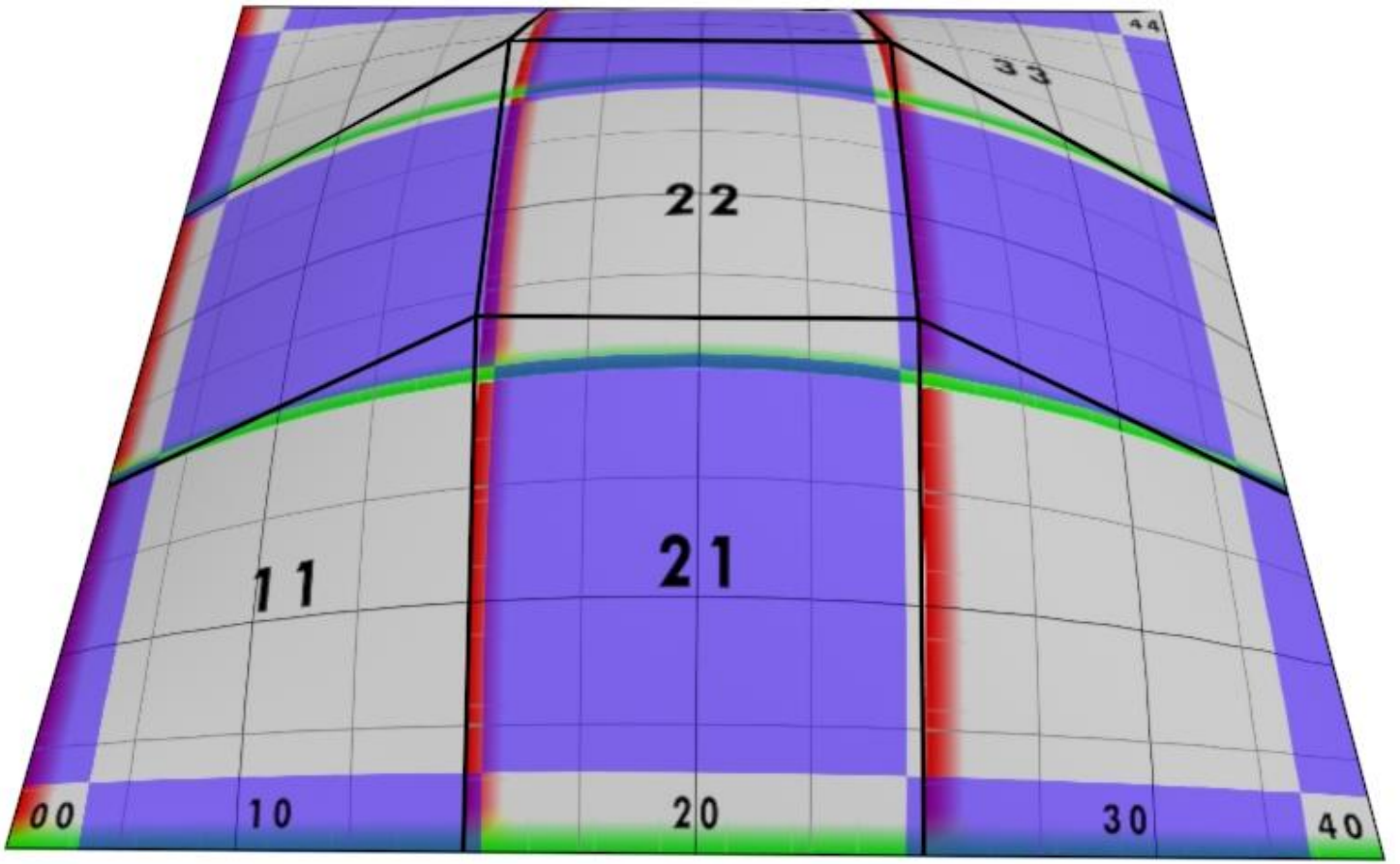
Parche22

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}



Parche 22

Superficies de múltiples parches



0 2 4

1 3

Condiciones de borde - 1 dimensión

REPETICION

REPETICION

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

+u

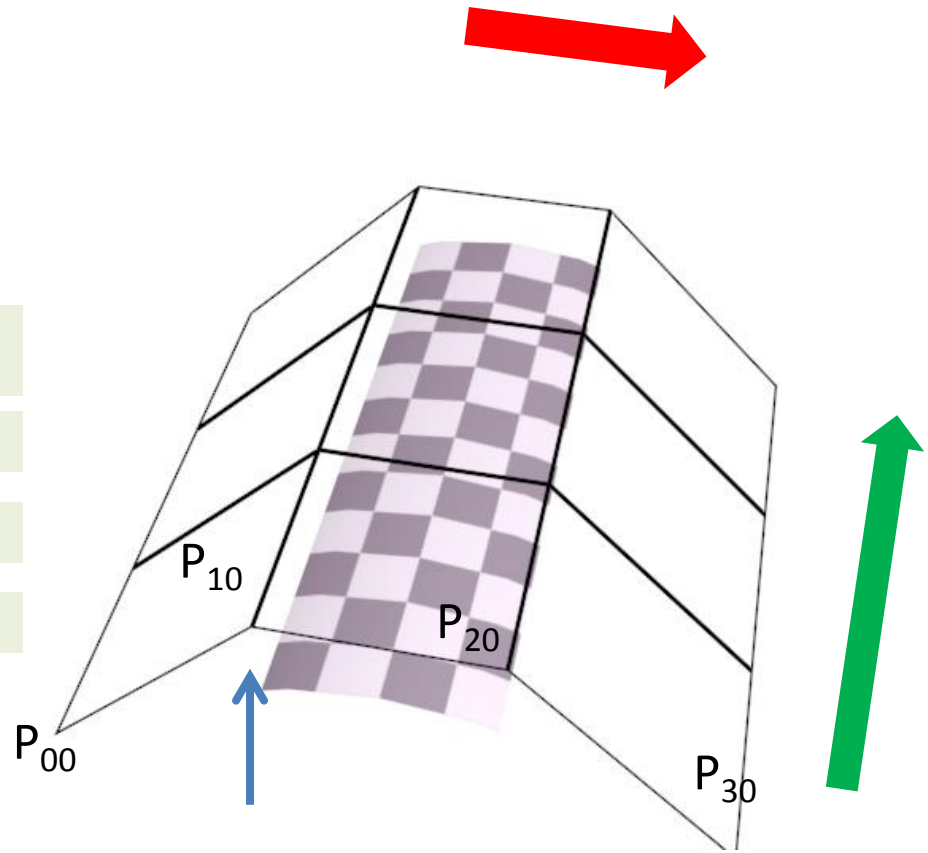
Parche1

Parche2

Parche3

Parche4

Parche5



S(u,v) interpola la curva formada por P00, P10,P20 y P30

16 Puntos de Control únicos

Condiciones de borde - 1 dimensión

CICLO **j**=0,1,2,3 0,1,2

+v

P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}	P_{02}
P_{10}	P_{11}	P_{12}	P_{13}	P_{10}	P_{11}	P_{12}
P_{20}	P_{21}	P_{22}	P_{23}	P_{20}	P_{21}	P_{22}
P_{30}	P_{31}	P_{32}	P_{33}	P_{30}	P_{31}	P_{32}

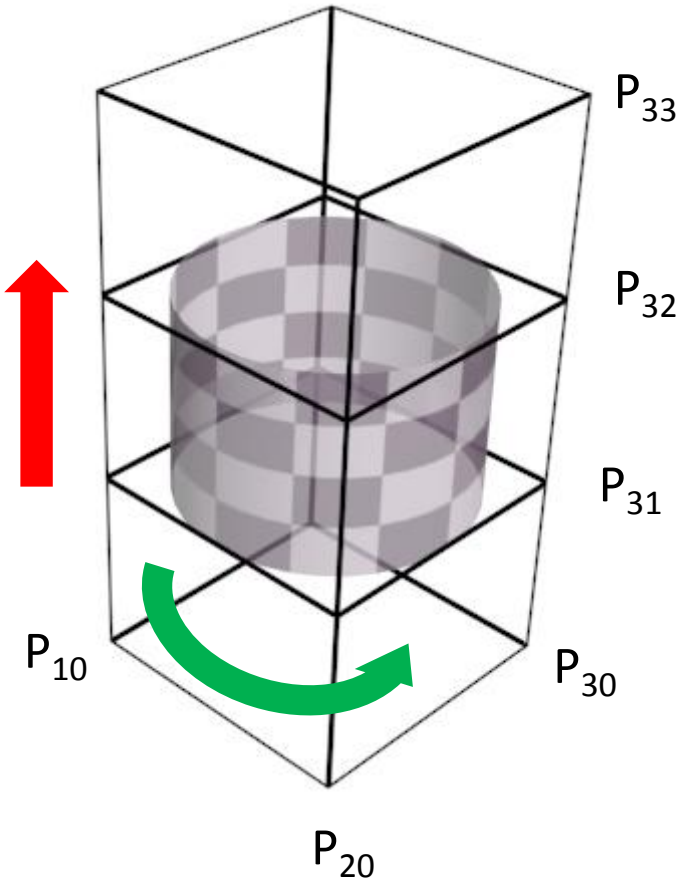
+u

Parche1

Parche2

Parche3

Parche4



S(u,v) es cerrada en el sentido de u.
Esta compuesta por 4 parches que cubre 90º del cilindro c/u

16 Puntos de control únicos

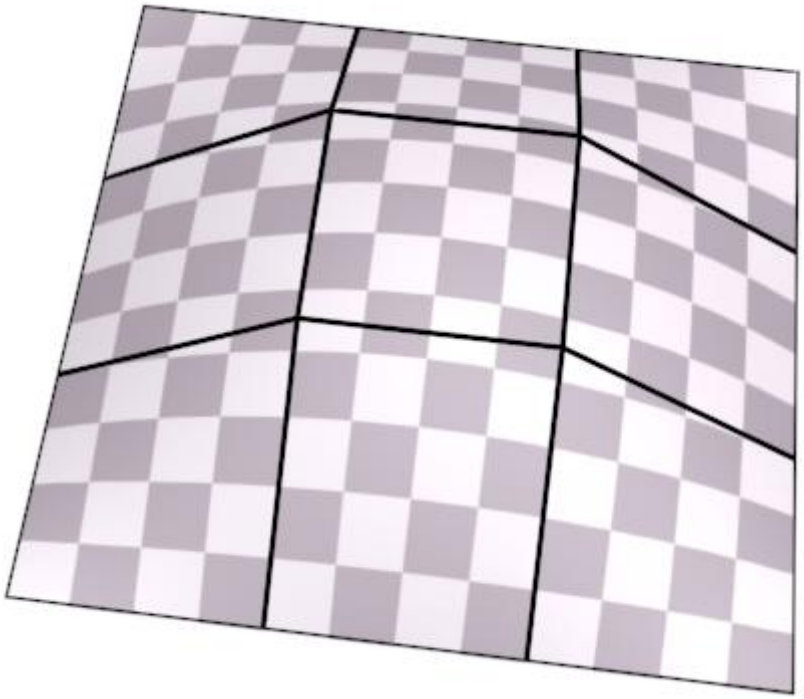
Condiciones de borde - 2 dimensiones

Hay **REPETICION** de los bordes en sentido de u y de v

P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{00}	P_{00}	P_{00}	P_{01}	P_{02}	P_{03}	P_{03}	P_{03}
P_{10}	P_{10}	P_{10}	P_{11}	P_{12}	P_{13}	P_{13}	P_{13}
P_{20}	P_{20}	P_{20}	P_{21}	P_{22}	P_{23}	P_{23}	P_{23}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}
P_{30}	P_{30}	P_{30}	P_{31}	P_{32}	P_{33}	P_{33}	P_{33}

+v

+u



S(u,v) interpola las curvas de formadas por los puntos de control de los bordes

Condiciones de borde - 2 dimensiones

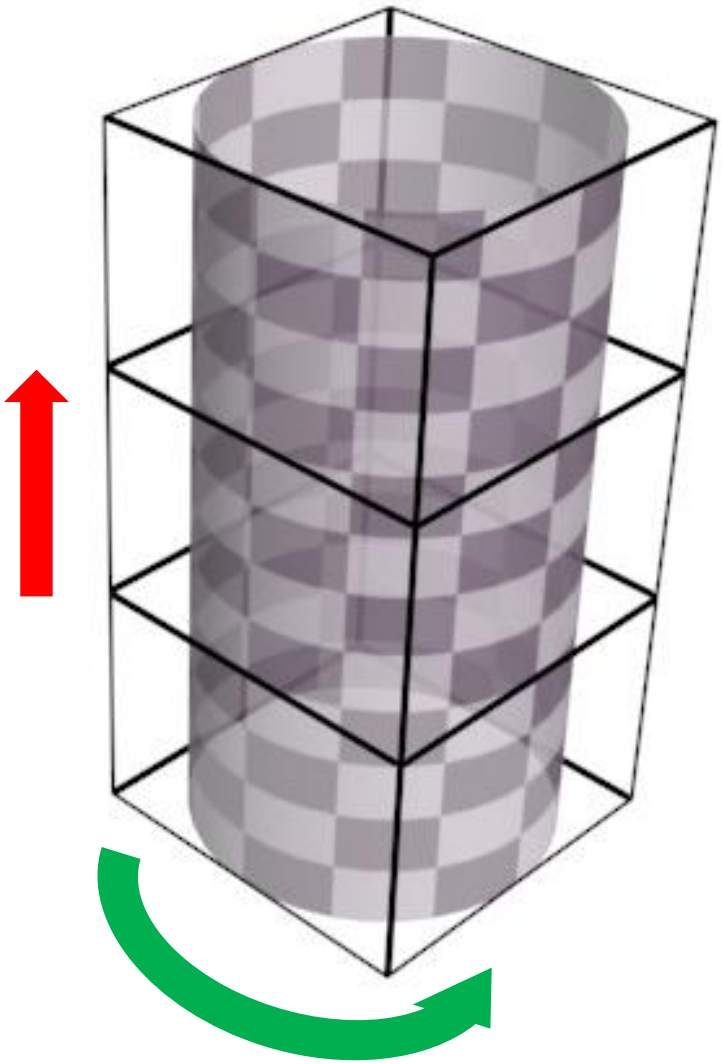
REPETICION de bordes en sentido de v

CICLO en el sentido u

P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}	P_{02}
P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}	P_{02}
P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}	P_{02}
P_{10}	P_{11}	P_{12}	P_{13}	P_{10}	P_{11}	P_{12}
P_{20}	P_{21}	P_{22}	P_{23}	P_{20}	P_{21}	P_{22}
P_{30}	P_{31}	P_{32}	P_{33}	P_{30}	P_{31}	P_{32}
P_{30}	P_{31}	P_{32}	P_{33}	P_{30}	P_{31}	P_{32}
P_{30}	P_{31}	P_{32}	P_{33}	P_{30}	P_{31}	P_{32}

+v

+u



Ejemplos

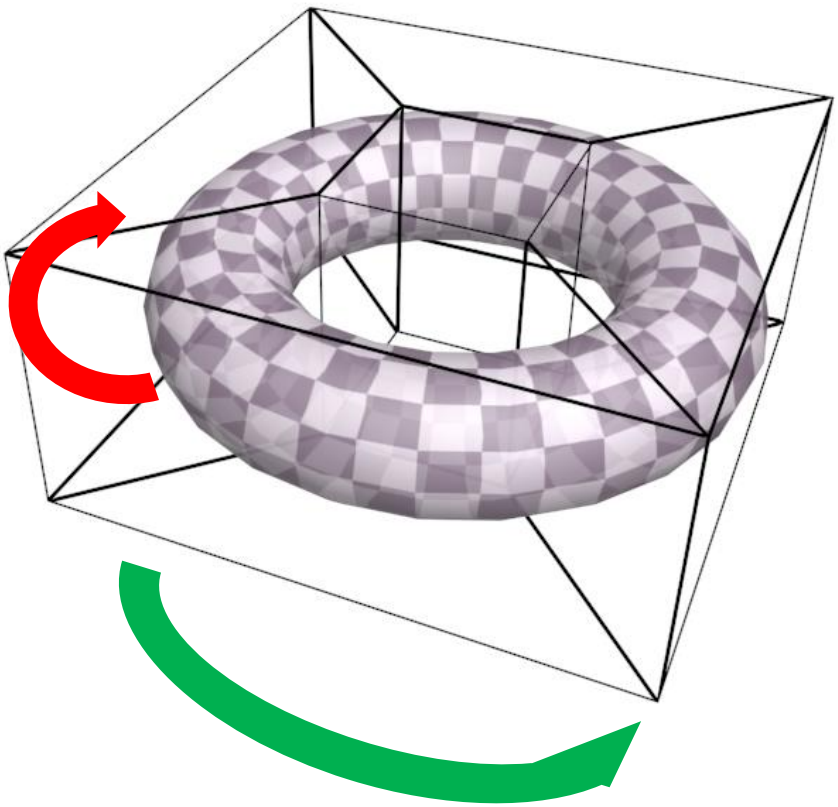
CICLO en sentido de v

CICLO en el sentido u

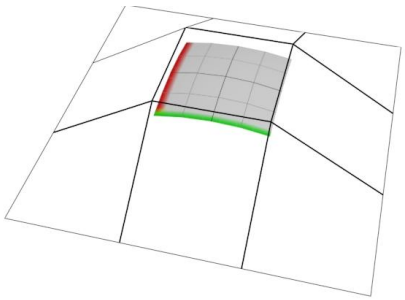
+v

P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}
P_{10}	P_{11}	P_{12}	P_{13}	P_{10}	P_{11}
P_{20}	P_{21}	P_{22}	P_{23}	P_{20}	P_{21}
P_{30}	P_{31}	P_{32}	P_{33}	P_{30}	P_{31}
P_{00}	P_{01}	P_{02}	P_{03}	P_{00}	P_{01}
P_{10}	P_{11}	P_{12}	P_{13}	P_{10}	P_{11}
P_{20}	P_{21}	P_{22}	P_{23}	P_{20}	P_{21}

+u

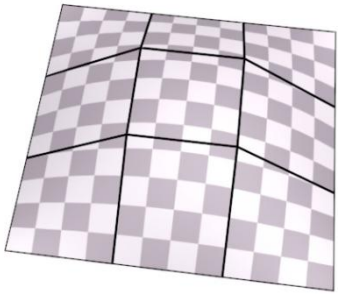


Condiciones de borde - Resumen



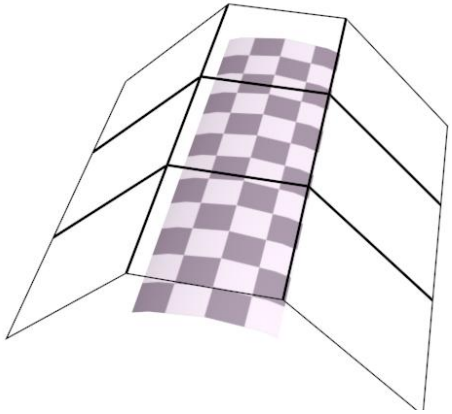
1 vez

1 vez



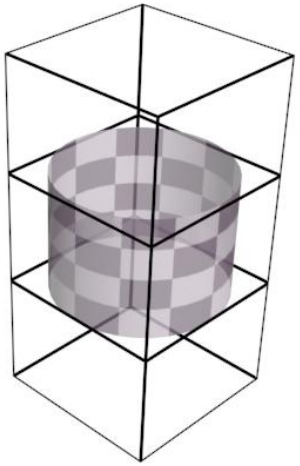
REPETICION

REPETICION



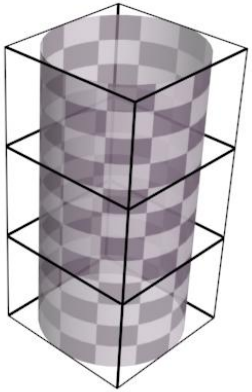
REPETICION

1 vez



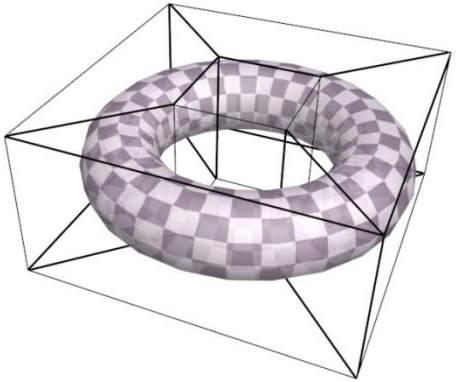
1 vez

CICLO



REPETICION

CICLO



CICLO

CICLO