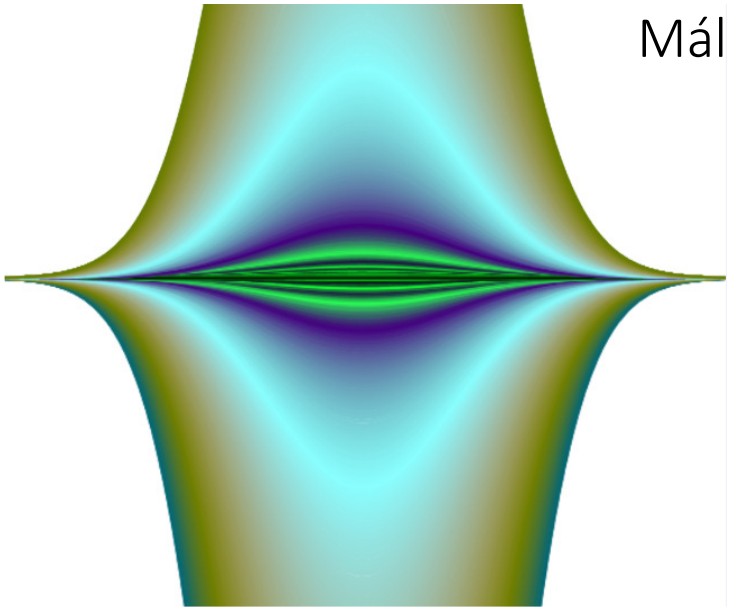
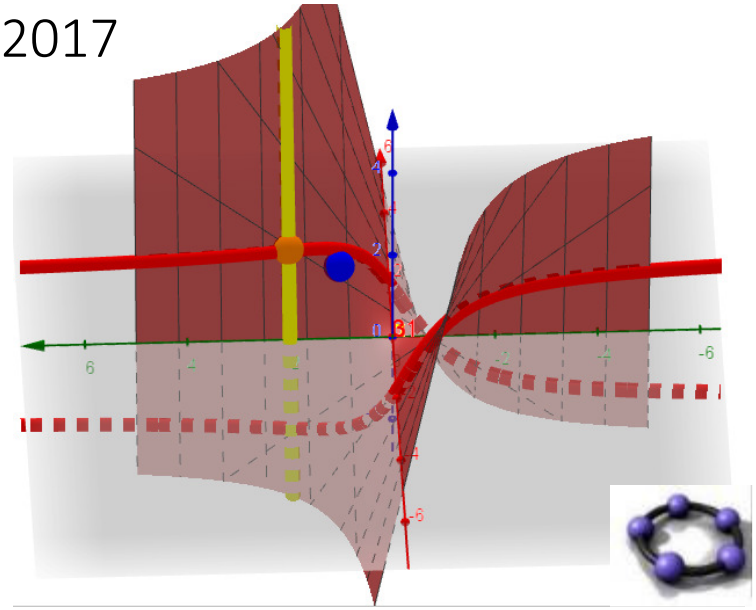
GeoGebra, un primer paso para diseñar la Arquitectura Dinámica del Siglo XXI

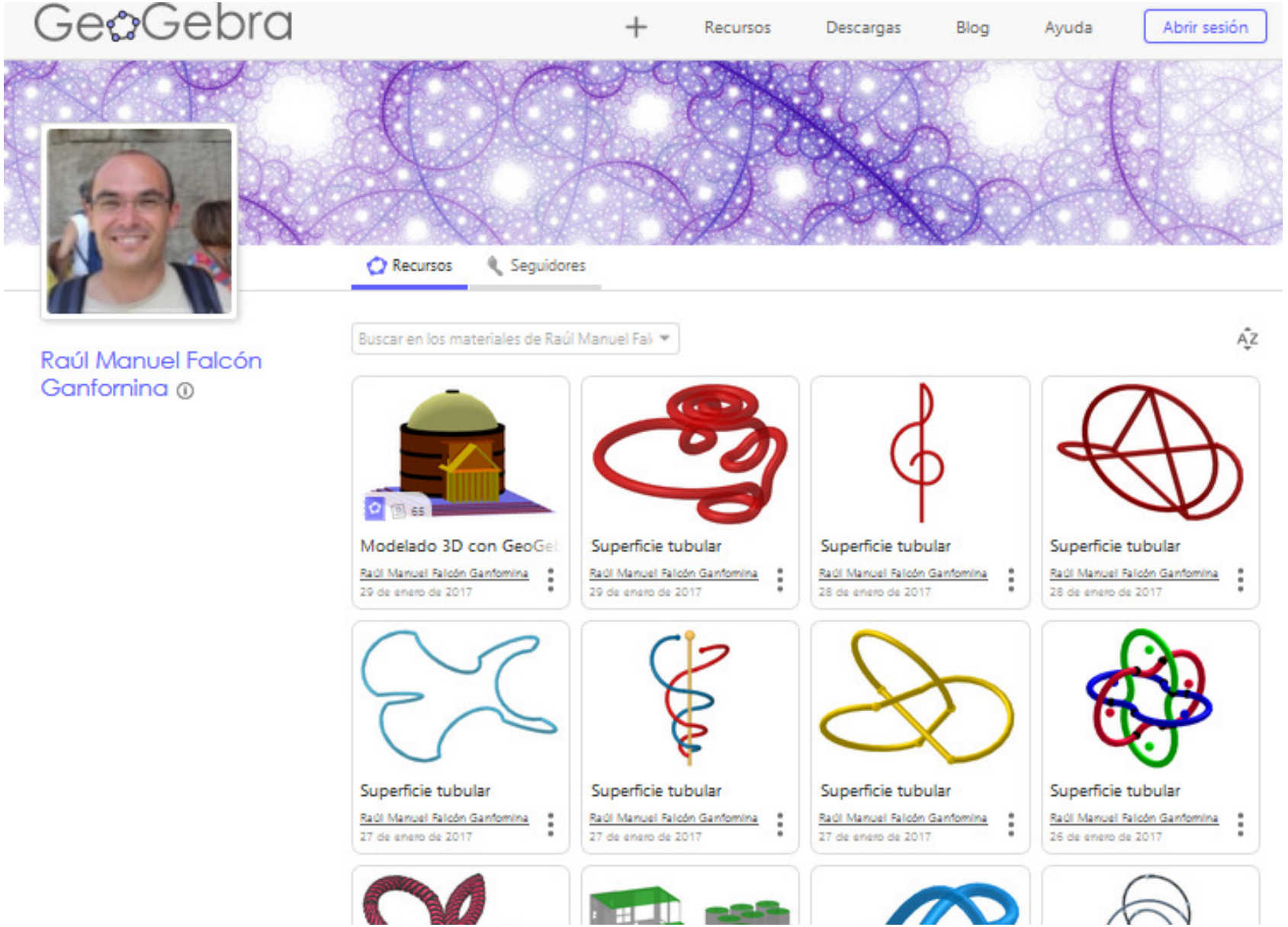
Raúl M. Falcón Ganfornina
rafalgan@us.es

V Encuentro en Andalucía GeoGebra en el aula

Málaga, 22 de abril de 2017







https://www.geogebra.org/raúl+falcón

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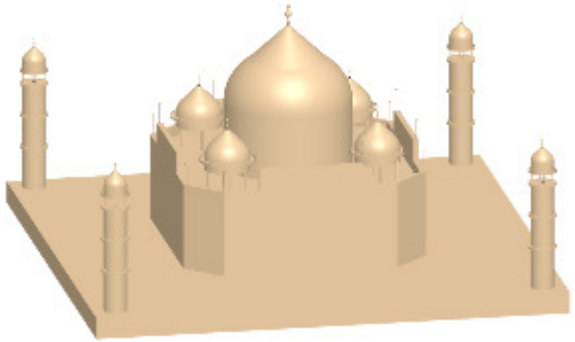
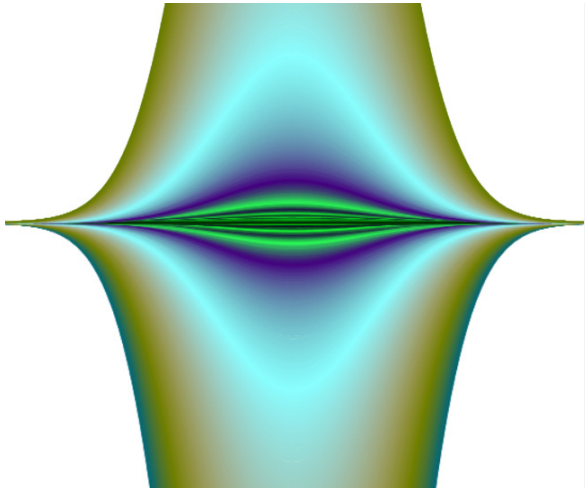


Diseños basados en EDO's y Geometría Diferencial.



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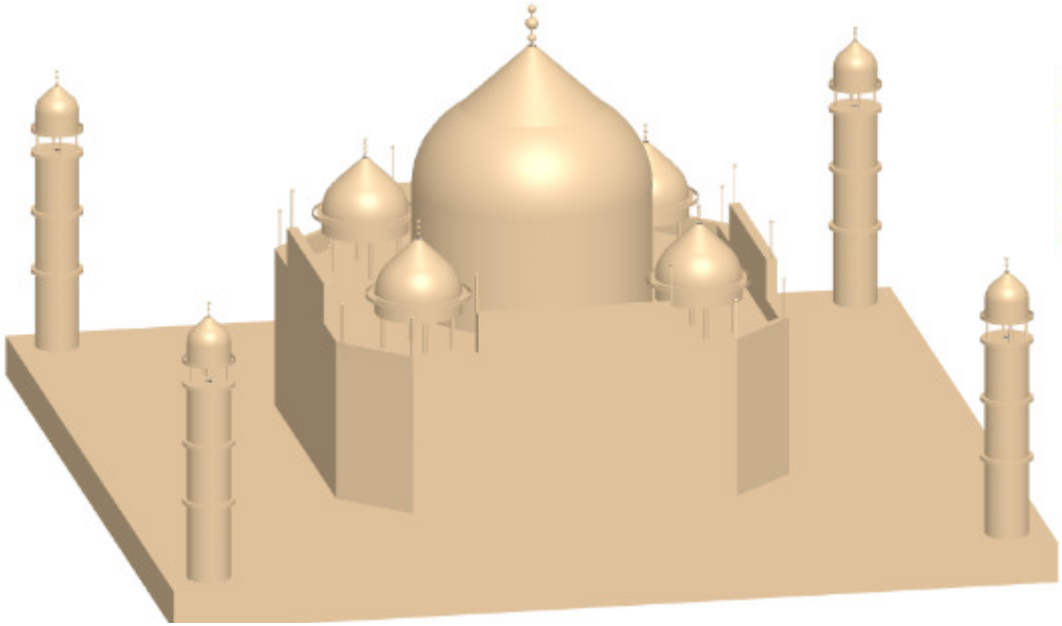
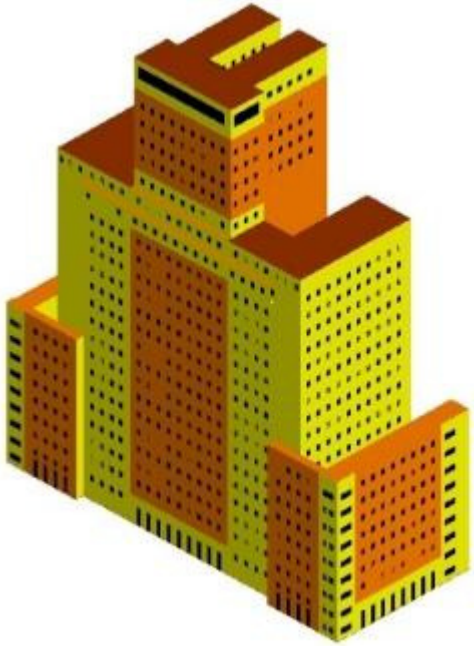
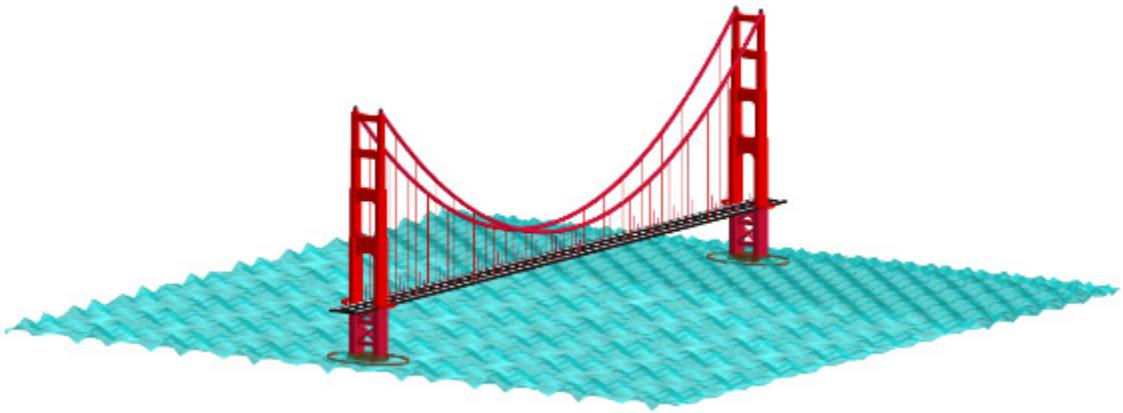
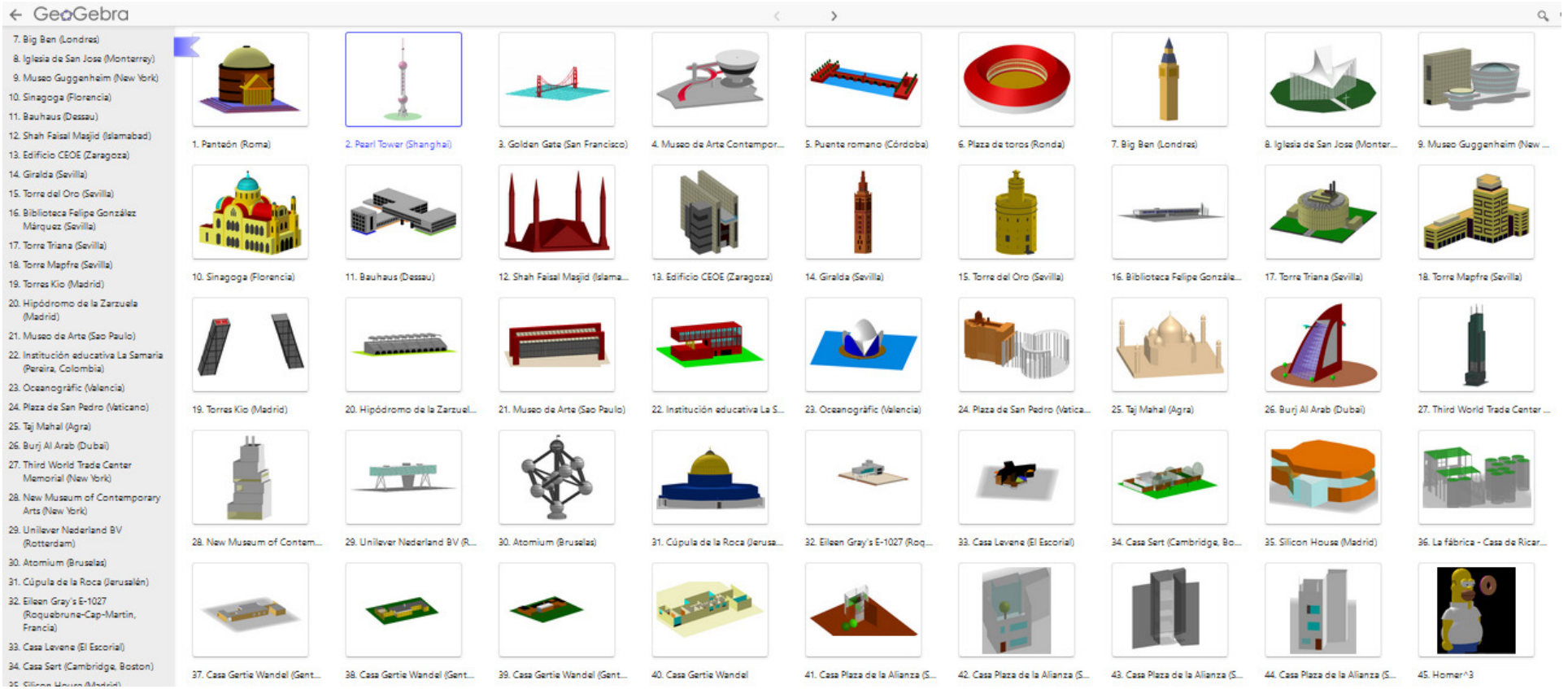






Modelado 3D


GeoGebra
7. Big Ben (Londres)
8. Iglesia de San Jose (Monterrey)
9. Museo Guggenheim (New York)
10. Sinagoga (Florencia)
11. Bauhaus (Dessau)
12. Shah Faisal Masjid (Islamabad)
13. Edificio CEOE (Zaragoza)
14. Giralda (Sevilla)
15. Torre del Oro (Sevilla)
16. Biblioteca Felipe González Márquez (Sevilla)
17. Torre Triana (Sevilla)
18. Torre Mapfre (Sevilla)
19. Torres Kio (Madrid)
20. Hipódromo de la Zarzuela (Madrid)
21. Museo de Arte (Sao Paulo)
22. Institución educativa La Samaria (Pereira, Colombia)
23. Oceanogràfic (Valencia)
24. Plaza de San Pedro (Vaticano)
25. Taj Mahal (Agra)
26. Burj Al Arab (Dubai)
27. Third World Trade Center Memorial (New York)
28. New Museum of Contemporary Arts (New York)
29. Unilever Nederland BV (Rotterdam)
30. Atomium (Bruselas)
31. Cúpula de la Roca (Jerusalén)
32. Eileen Gray's E-1027 (Roquebrune-Cap-Martin, Francia)
33. Casa Levene (El Escorial)
34. Casa Sart (Cambridge, Boston)
1. Pantaón (Roma)
2. Pearl Tower (Shanghai)
3. Golden Gate (San Francisco)
4. Museo de Arte Contempor...
5. Puente romano (Córdoba)
6. Plaza de toros (Ronda)
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8. Iglesia de San Jose (Monter...
9. Museo Guggenheim (New ...
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11. Bauhaus (Dessau)
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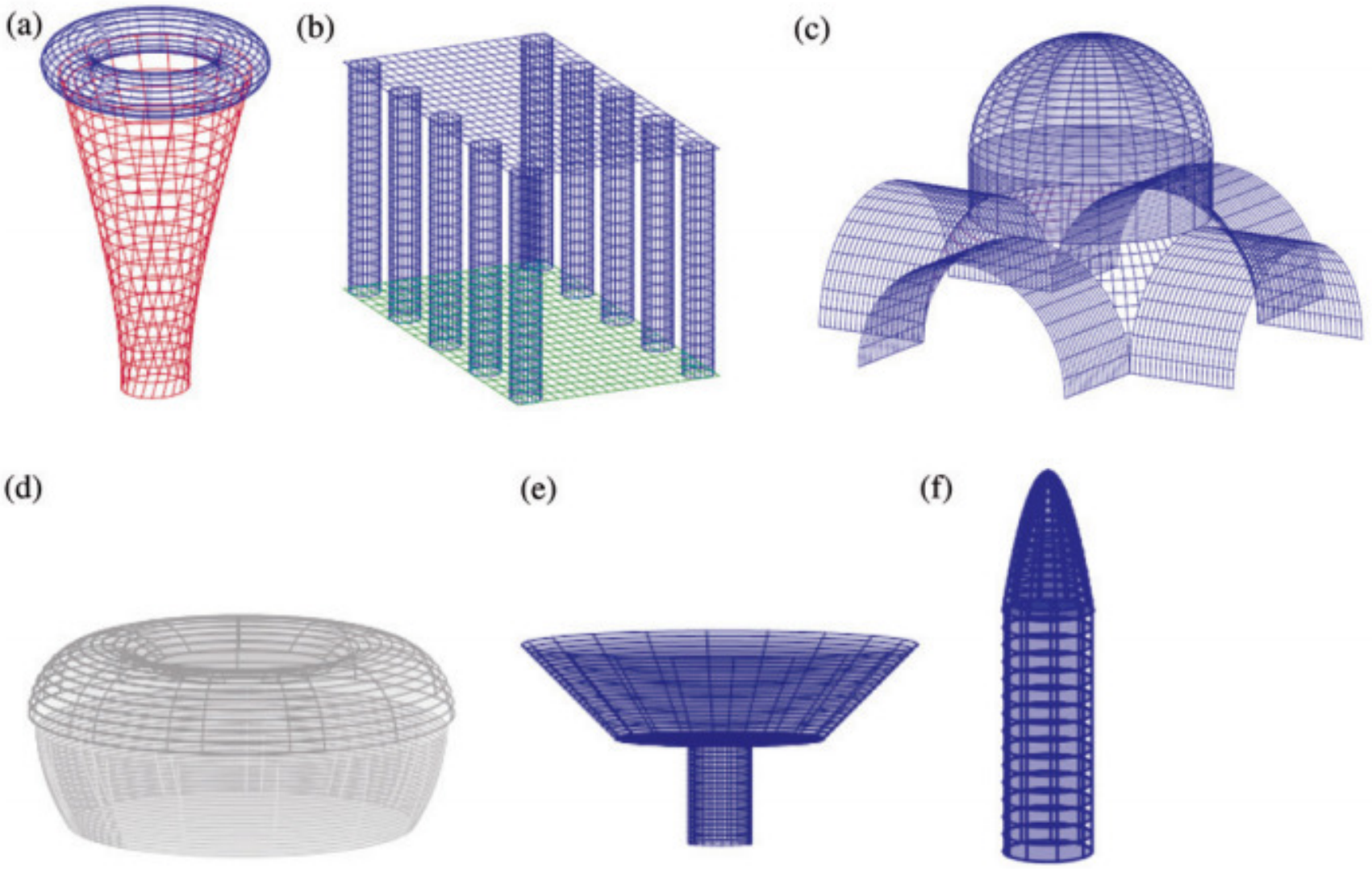
32. Eileen Gray's E-1027 (Roq...
33. Casa Levene (El Escorial)
34. Casa Sart (Cambridge, Bo...
35. Silicon House (Madrid)
36. La fábrica - Casa de Ricar...
37. Casa Gertie Wandel (Gent...
38. Casa Gertie Wandel (Gent...
39. Casa Gertie Wandel (Gent...
40. Casa Gertie Wandel
41. Casa Plaza de la Alianza (S...
42. Casa Plaza de la Alianza (S...
43. Casa Plaza de la Alianza (S...
44. Casa Plaza de la Alianza (S...
45. Homer^3

Modelado 3D



Modelado 3D

Ángulos de Euler

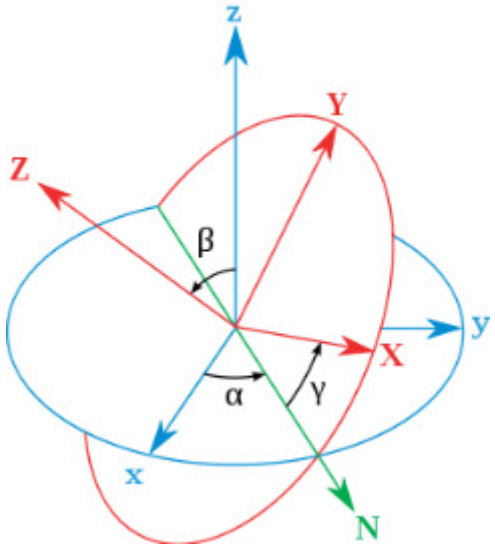
Proyección ortogonal 3D en 2D:

$$f : \mathrm{R}^3 \rightarrow \mathrm{R}^2$$

$$\vec{x} = (x, y, z) \rightarrow f\left(\vec{x}\right) = \left(f_1\left(\vec{x}\right), f_2\left(\vec{x}\right)\right)$$

$$f_1\left(\vec{x}\right) = x\sin(\beta) + y\cos(\beta)$$

$$f_2\left(\vec{x}\right) = -x\cos(\beta)\sin(\alpha) + y\sin(\beta)\sin(\alpha) + z\cos(\alpha)$$



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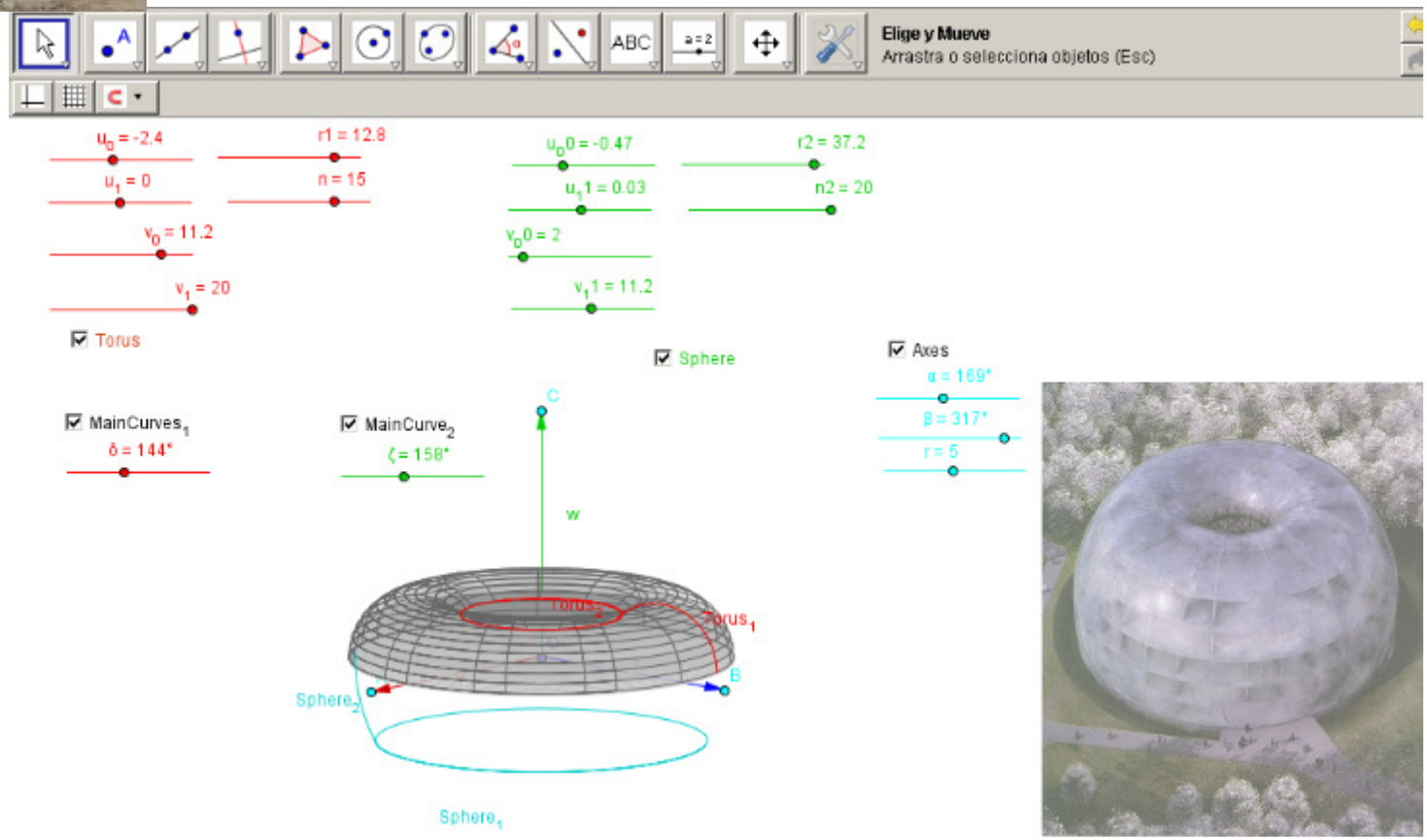
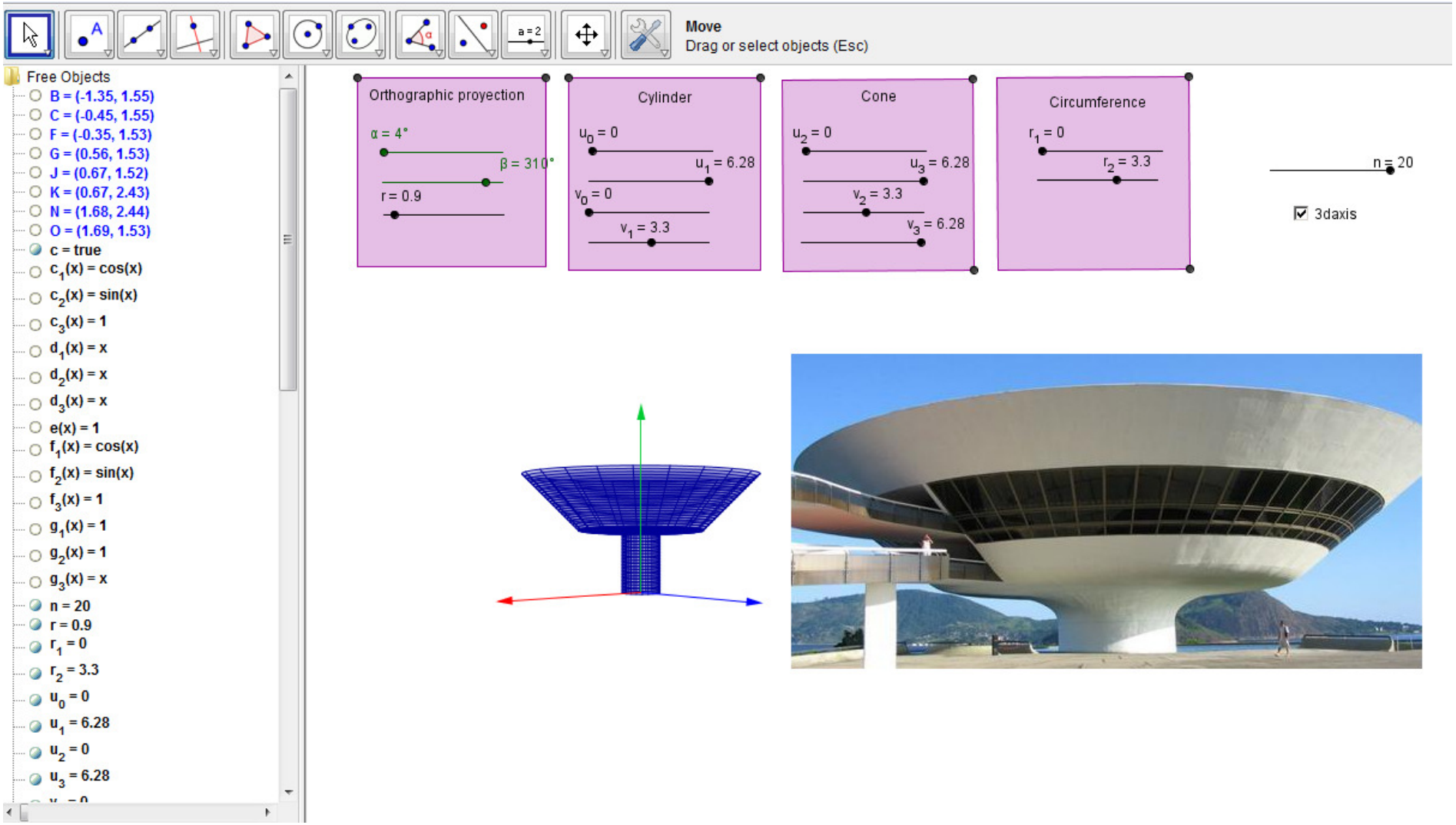
Modelado 3D

INSTITUTO DE MEDICINA LEGAL
(Alejandro Zaera)
Madrid (Campus de la Justicia)



José Enrique Pozo Sierra
Curso 2009-2010

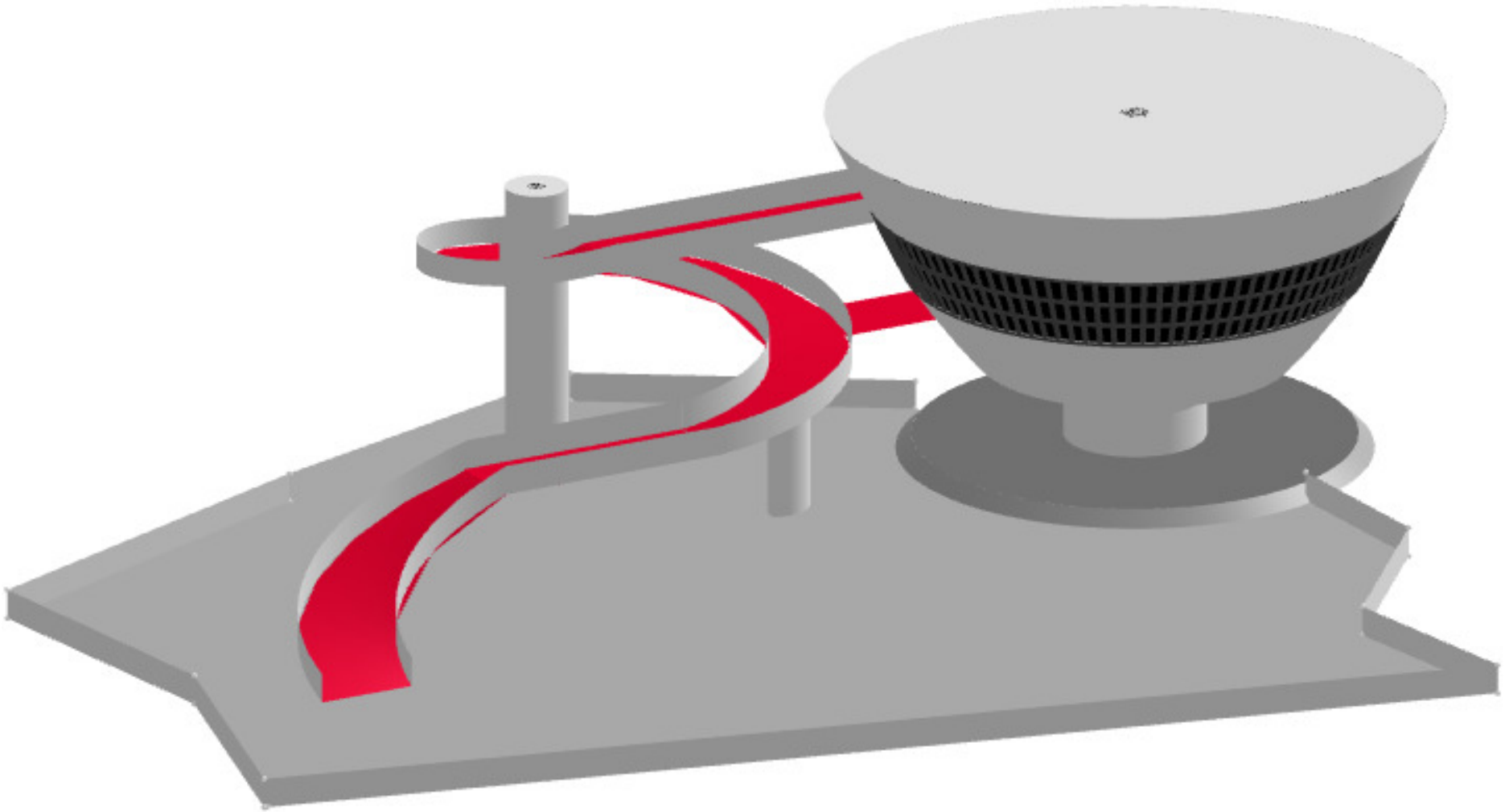
Modelado 3D



MUSEO DE ARTE CONTEMPORÁNEO (1996)
(Óscar Niemeyer)
Niteroi, Brasil

Miriam González Roca
Curso 2009-2010

Modelado 3D



MUSEO DE ARTE CONTEMPORÁNEO (1996)
(Óscar Niemeyer)
Niteroi, Brasil

Manuel Delgado Liébana
Curso 2015-2016

Modelado 3D

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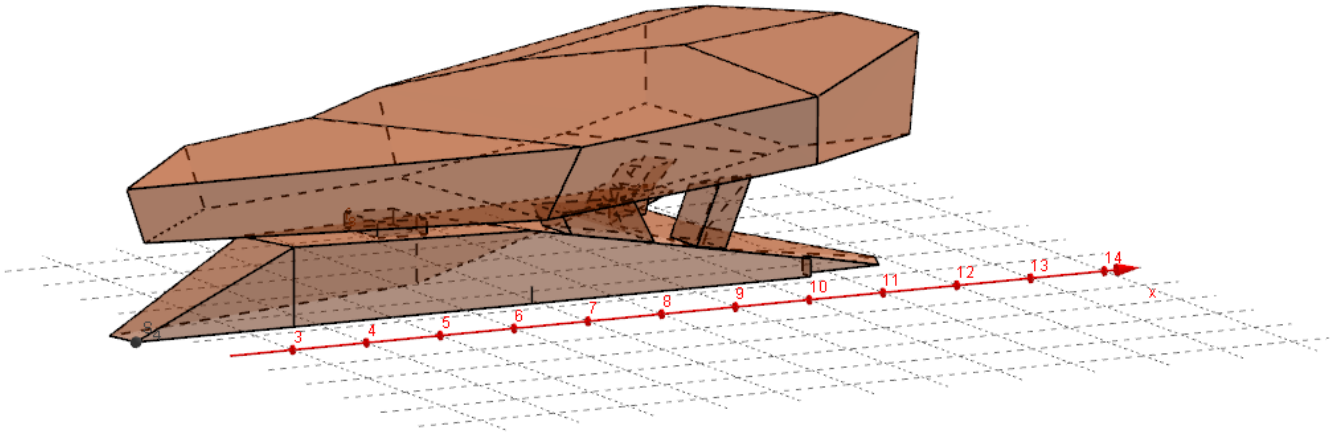
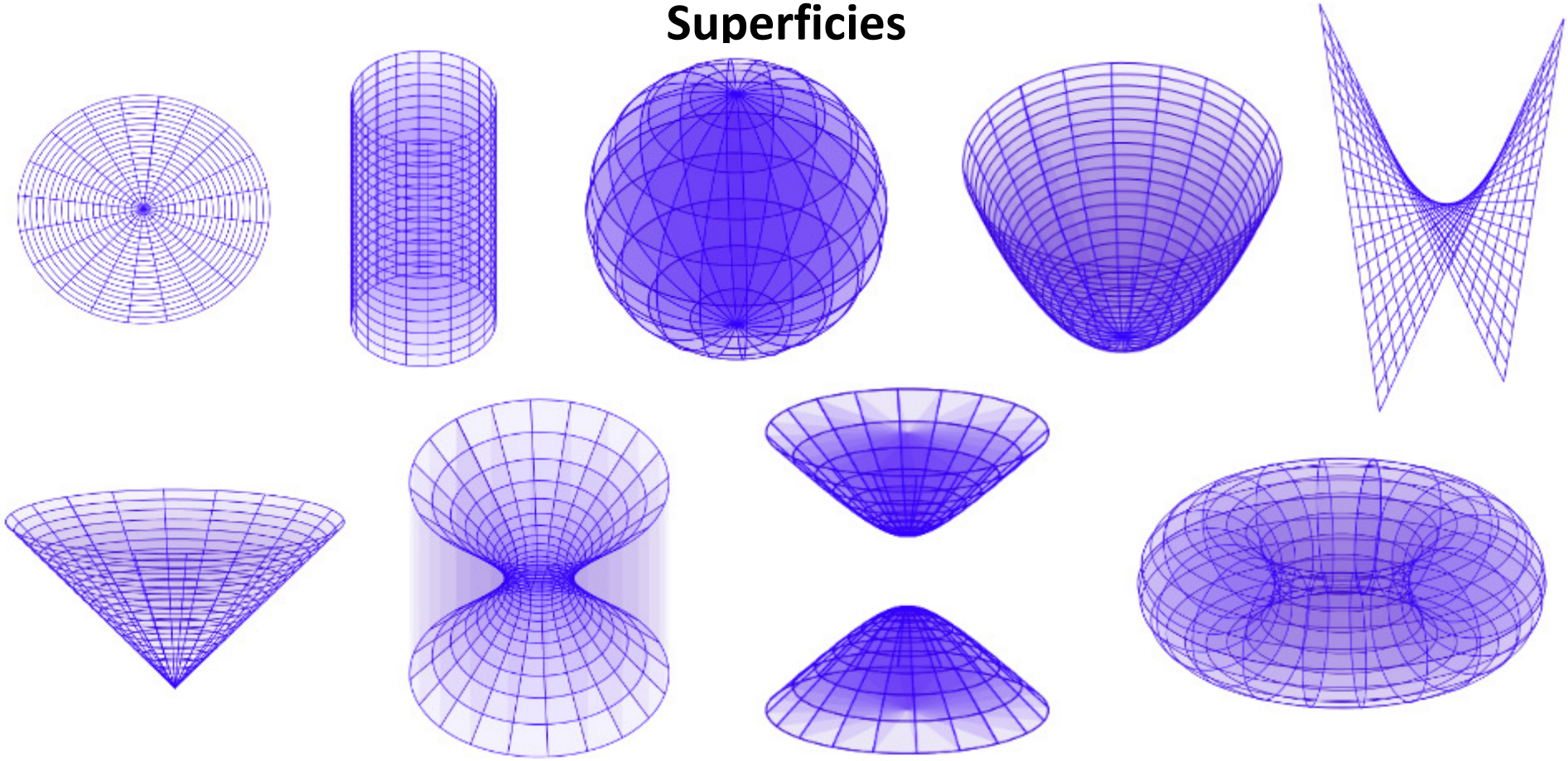
MUSEO PORSCHE (2009)
(Delugan Meissl)
Stuttgart



Carlos Palacios Gil
Curso 2011-2012

Modelado 3D

Superficies



Modelado 3D

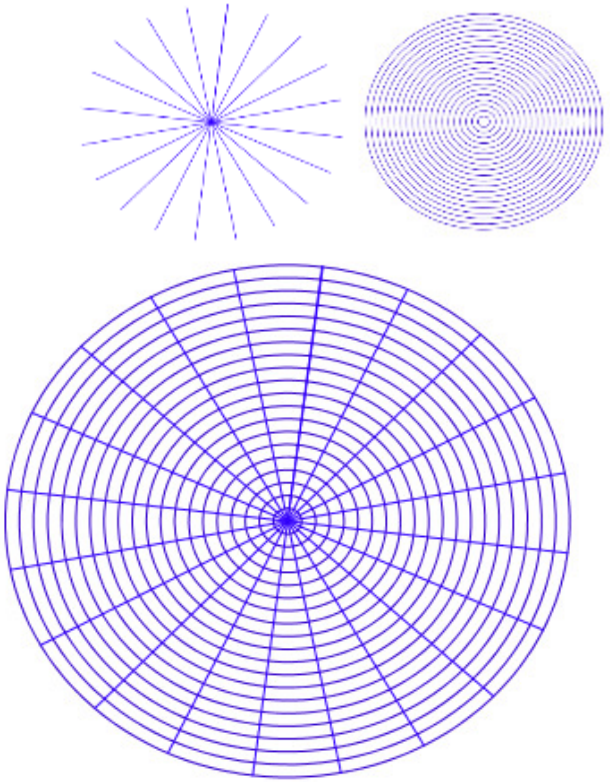
Disco

ALDAR HEADQUARTERS (2010)
110 metros
(MZ Architects)
Abu Dhabi

$$\begin{cases} x = u\cos(v), \\ y = u\sin(v), \\ z = 0. \end{cases}$$

$$u \in [0, a]$$

$$v \in [0, 2\pi]$$



Modelado 3D

© Wikipedia

WESTHAFEN TOWER (2004)
109,9 metros
(Schneider & Schumacher)
Frankfurt

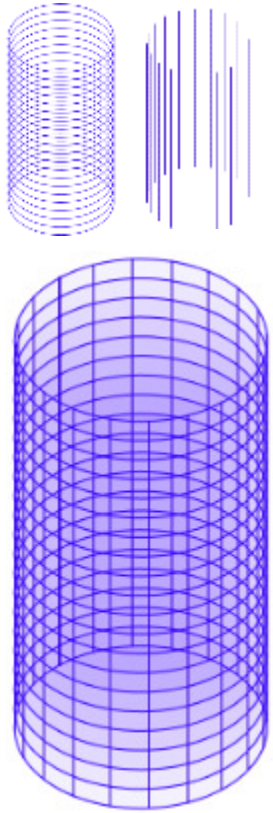
Cilindro

$$\begin{cases} x = \cos(u), \\ y = \sin(u), \\ z = v. \end{cases}$$

$$u \in [0, 2\pi]$$

$$v \in [a, b]$$

$$x^2 + y^2 = 1$$



Modelado 3D

© Wikipedia

ATOMIUM (1958)
102 metros
(André Waterkeyn)
Bruselas

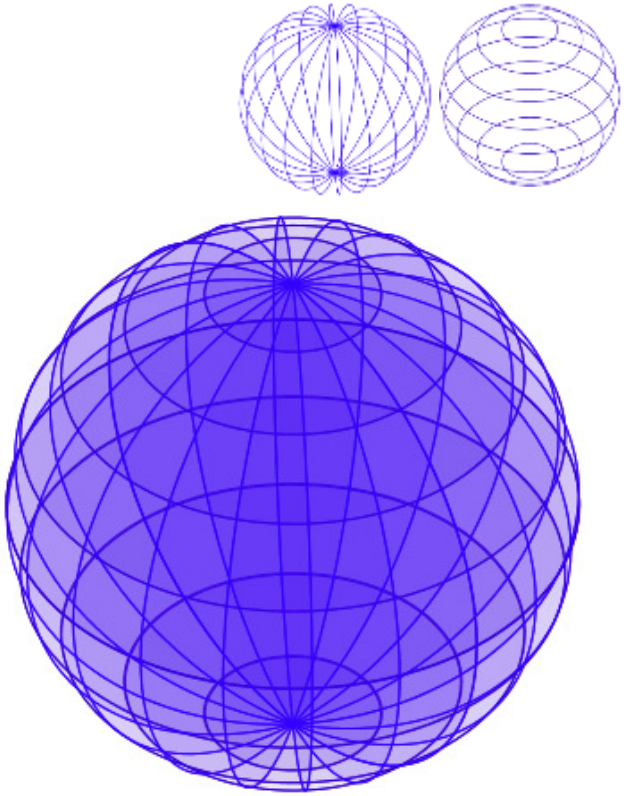
Esfera

$$\begin{cases} x = \cos(u)\cos(v), \\ y = \cos(u)\sin(v), \\ z = \sin(u). \end{cases}$$

$$u \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$$

$$v \in [0, 2\pi]$$

$$x^2 + y^2 + z^2 = 1$$



Modelado 3D

Elipsoide

© Planetden

BEIJING NATIONAL GRAND THEATRE (2008)
(Paul Andreu)
Pekín

$$\begin{cases} x = R\cos(u)\cos(v), \\ y = r\cos(u)\sin(v), \\ z = \sin(u). \end{cases}$$

$$u \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$$

$$v \in [0, 2\pi]$$

$$x^2 + y^2 + z^2 = 1$$

Modelado 3D

© Wikipedia

THE GHERKIN (2003)
102 metros
(Norma Foster)
Londres

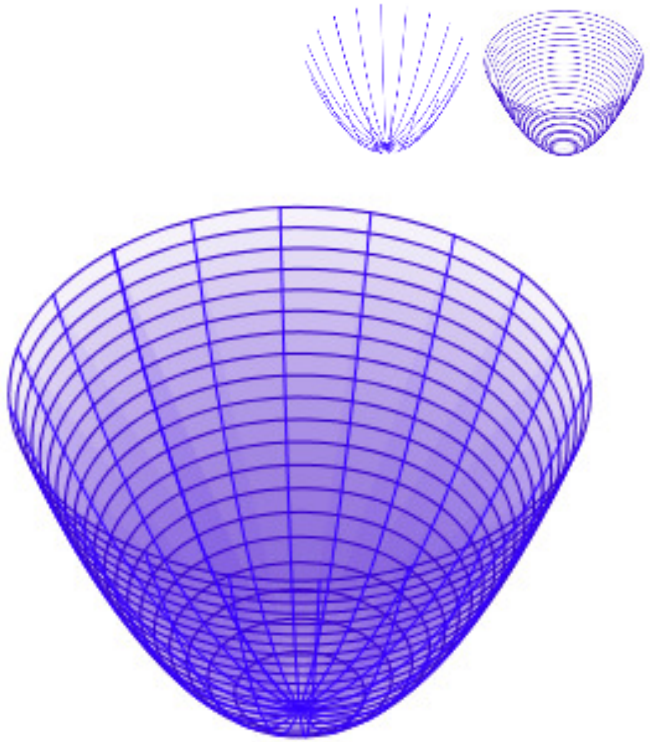
Paraboloide elíptico

$$\begin{cases} x = \sqrt{u}\cos(v), \\ y = \sqrt{u}\sin(v), \\ z = u. \end{cases}$$

$$u \in [0, a]$$

$$v \in [0, 2\pi]$$

$$x^2 + y^2 = z$$



Modelado 3D

Paraboloide hiperbólico

© Elnuevodia

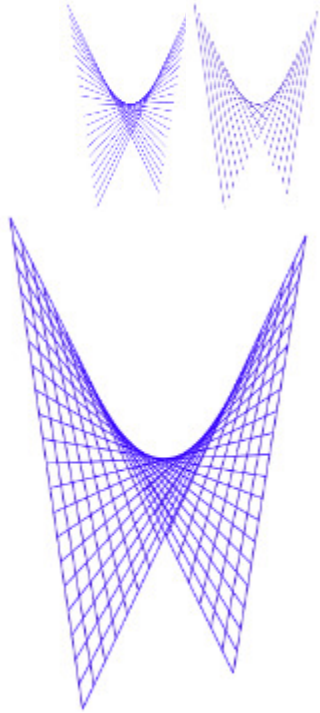
PABELLÓN PHILIPS (1958)
(Le Corbusier e Iannis Xenakis)
Bruselas

$$\begin{cases} x = u, \\ y = v, \\ z = u \cdot v. \end{cases}$$

$$u \in [a, b]$$

$$v \in [c, d]$$

$$x \cdot y = z$$



Modelado 3D

© Wikipedia

AUDITORIO DE TENERIFE (2003)
(Santiago Calatrava)
Tenerife

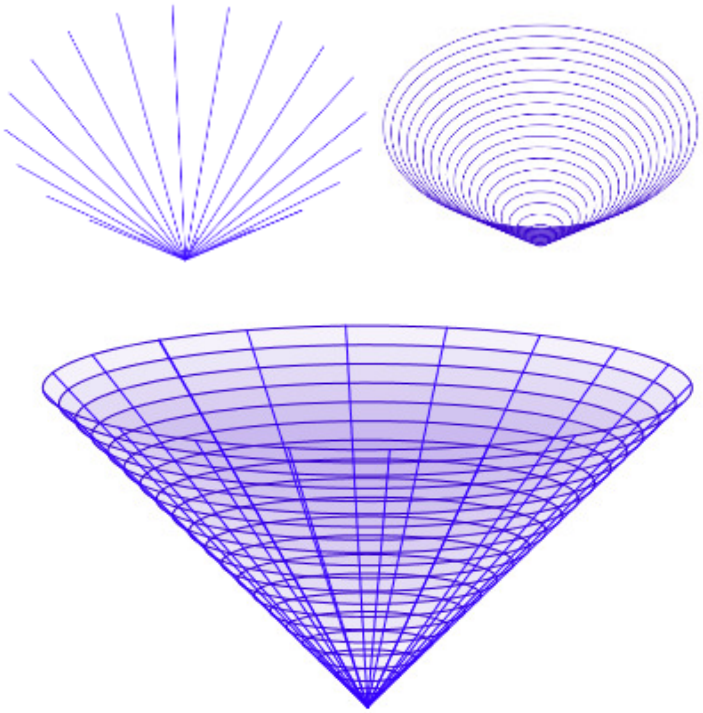
Cono

$$\begin{cases} x = u\cos(v), \\ y = u\sin(v), \\ z = u. \end{cases}$$

$$u \in [0, a]$$

$$v \in [0, 2\pi]$$

$$x^2 + y^2 = z^2$$



Modelado 3D

Hiperboloide de una hoja

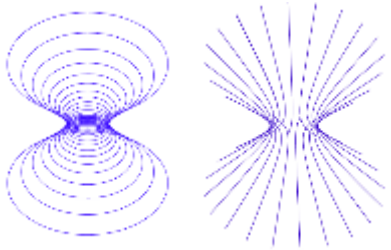
BOULEVARD EXPO SHANGHAI 2010
Shanghai

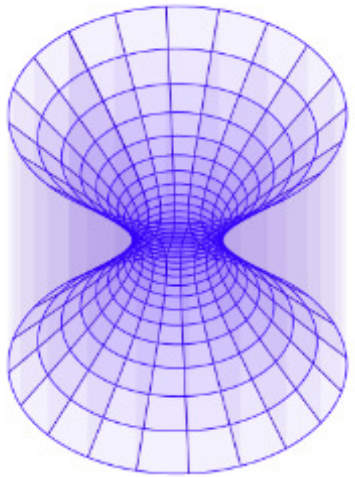
$$\begin{cases} x = \cos(u)\cosh(v), \\ y = \cos(u)\sinh(v), \\ z = \sin(u). \end{cases}$$

$$u \in [0, 2\pi]$$

$$v \in [a, b]$$

$$x^2 - y^2 + z^2 = 1$$





Modelado 3D

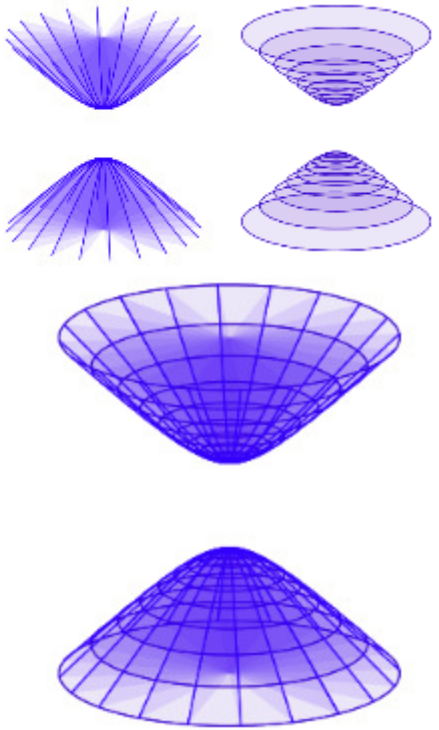
Hiperboloide de dos hojas

$$\begin{cases} x = \sinh(u)\cos(v), \\ y = \sinh(u)\sin(v), \\ z = \cosh(u). \end{cases}$$

$$u \in [a, b]$$

$$v \in [0, 2\pi]$$

$$x^2 + y^2 - z^2 = -1$$



Modelado 3D

Toro

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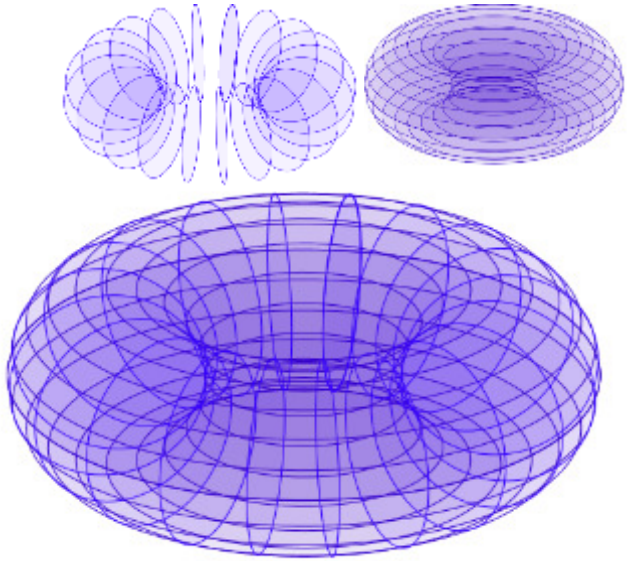
INSTITUTO DE MEDICINA LEGAL
(Alejandro Zaera)
Madrid (Campus de la Justicia)

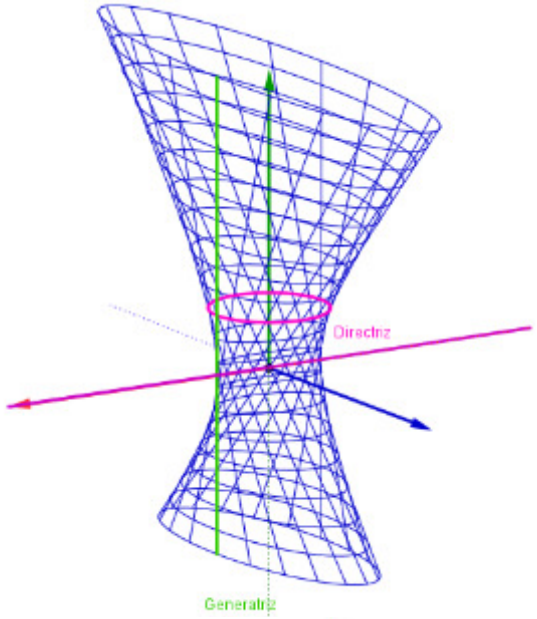
$$\begin{cases} x = (R + r\cos(u))\cdot\cos(v), \\ y = (R + r\cos(u))\cdot\sin(v), \\ z = r\sin(u). \end{cases}$$

$$u \in [0, 2\pi]$$

$$v \in [0, 2\pi]$$

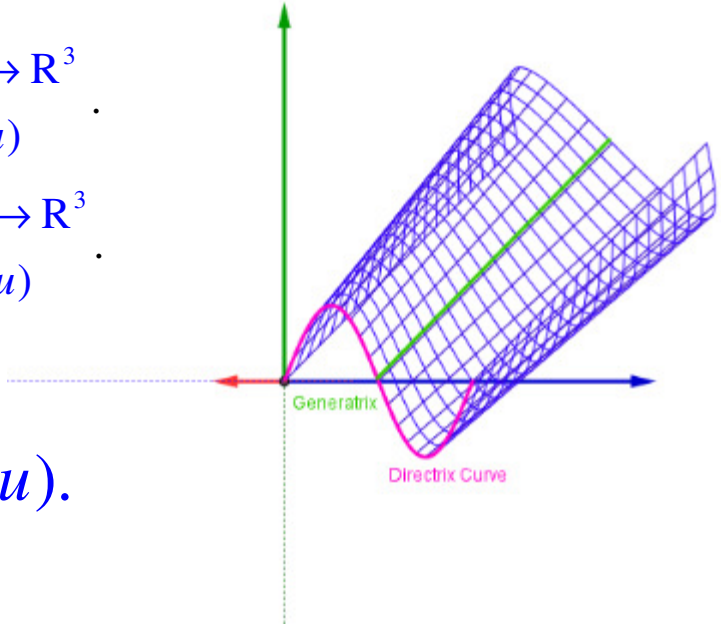


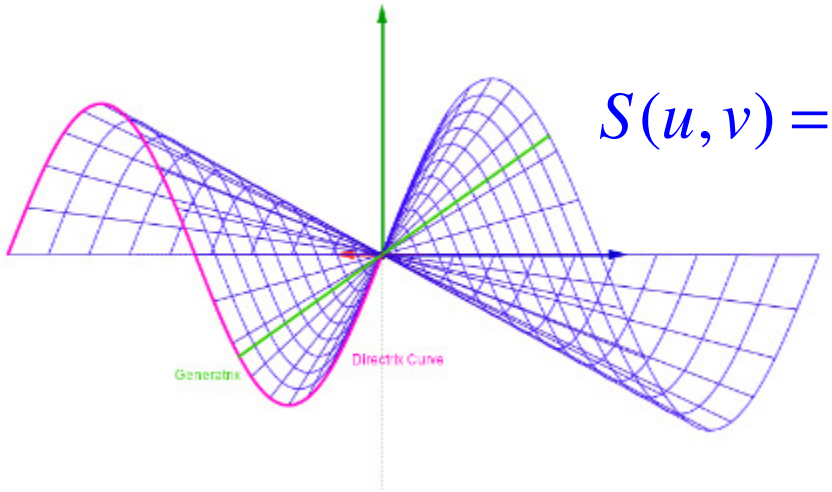
Modelado 3D



Superficies regladas

$$\begin{cases} \text{Curva directriz} \equiv \begin{cases} C : D \subseteq \mathrm{R} \to \mathrm{R}^3 \\ u \to C(u) \end{cases}. \\ \text{Curva directora} \equiv \begin{cases} \beta : D \subseteq \mathrm{R} \to \mathrm{R}^3 \\ u \to \beta(u) \end{cases}. \end{cases}$$





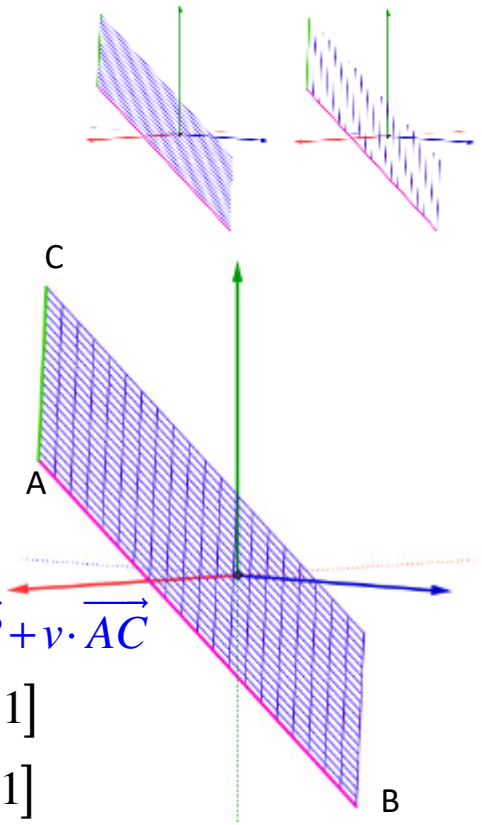
$$S(u,v) = C(u) + v \cdot \beta(u).$$

Modelado 3D

Superficies regladas: Plano

© Porshe

MUSEO PORSCHE (2009)
(Delugan Meissl)
Stuttgart



$$\begin{cases} C(u) = (a \cdot u + b, c \cdot u + d, e \cdot u + f)), \\ \beta(u) = (g, h, i). \end{cases} \quad A + u \cdot \overrightarrow{AB} + v \cdot \overrightarrow{AC}$$

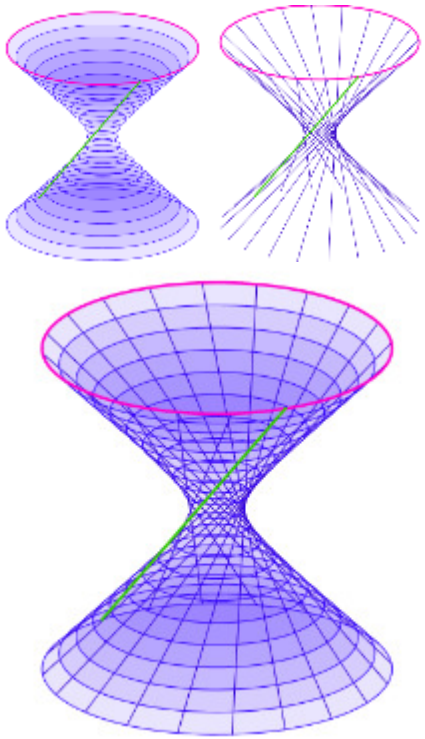
$$u \in [k, l] \qquad u \in [0,1] \qquad v \in [0,1]$$

Modelado 3D

Superficies regladas: Hiperboloide de una hoja

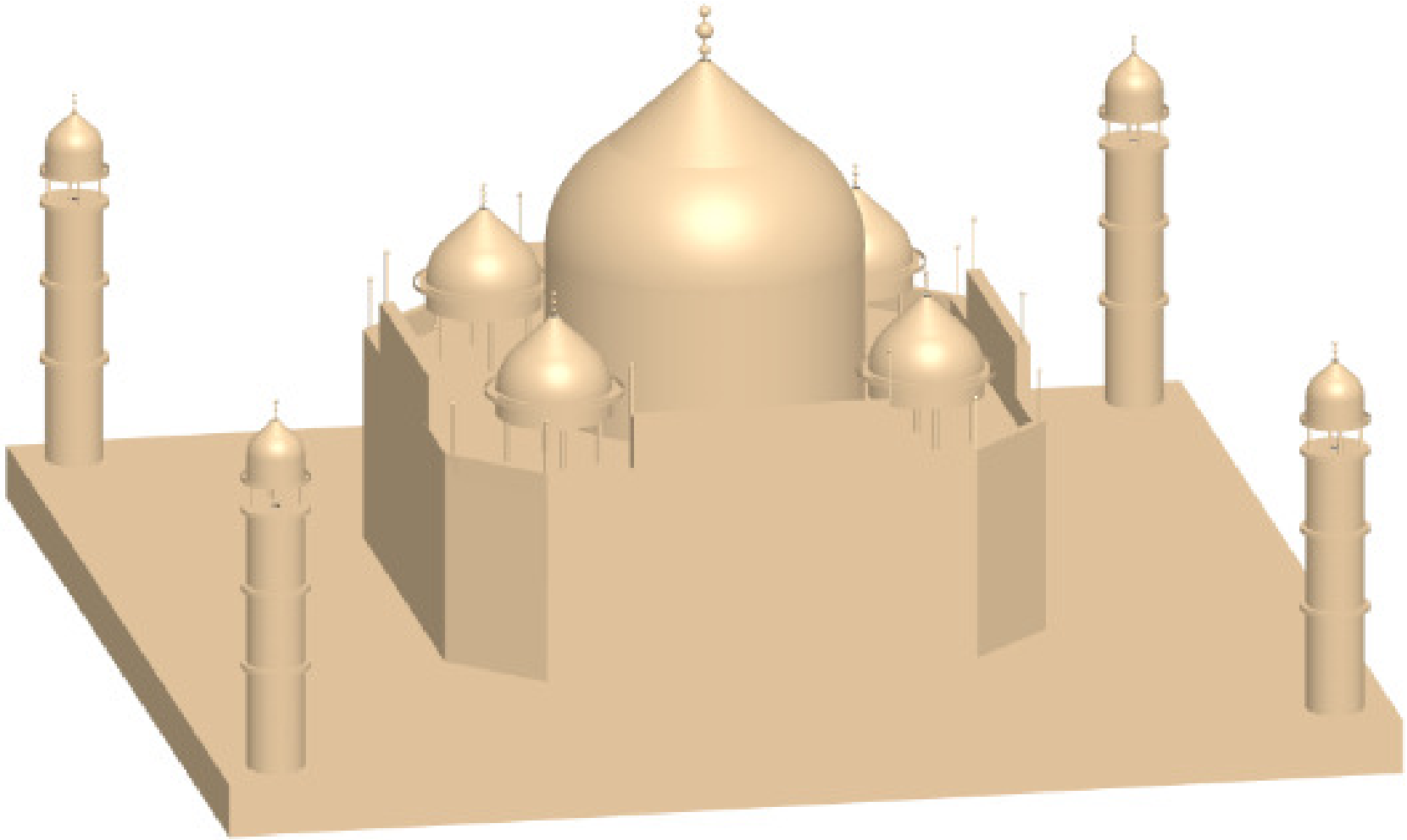
$$\begin{cases} C(u) = (\cos(u), \sin(u), 0)), \\ \beta(u) = (-\sin(u), \cos(u), 1). \end{cases}$$

$$u \in [0, 2\pi]$$



CORPORATION STREET BRIDGE (1999)
(Hodder + Partners)
Manchester

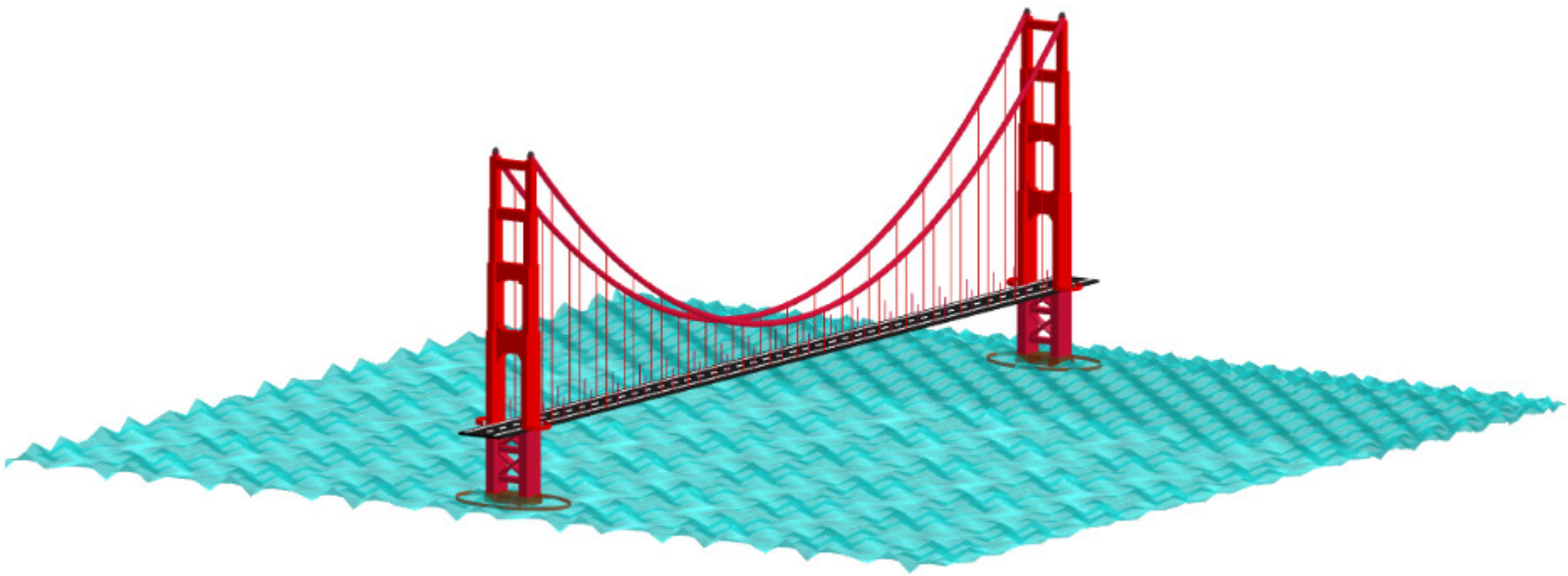
Modelado 3D



TAJ MAHAL (S. XVII)
Agra

Sandra María Garzón Ruíz
Curso 2015-2016

Modelado 3D



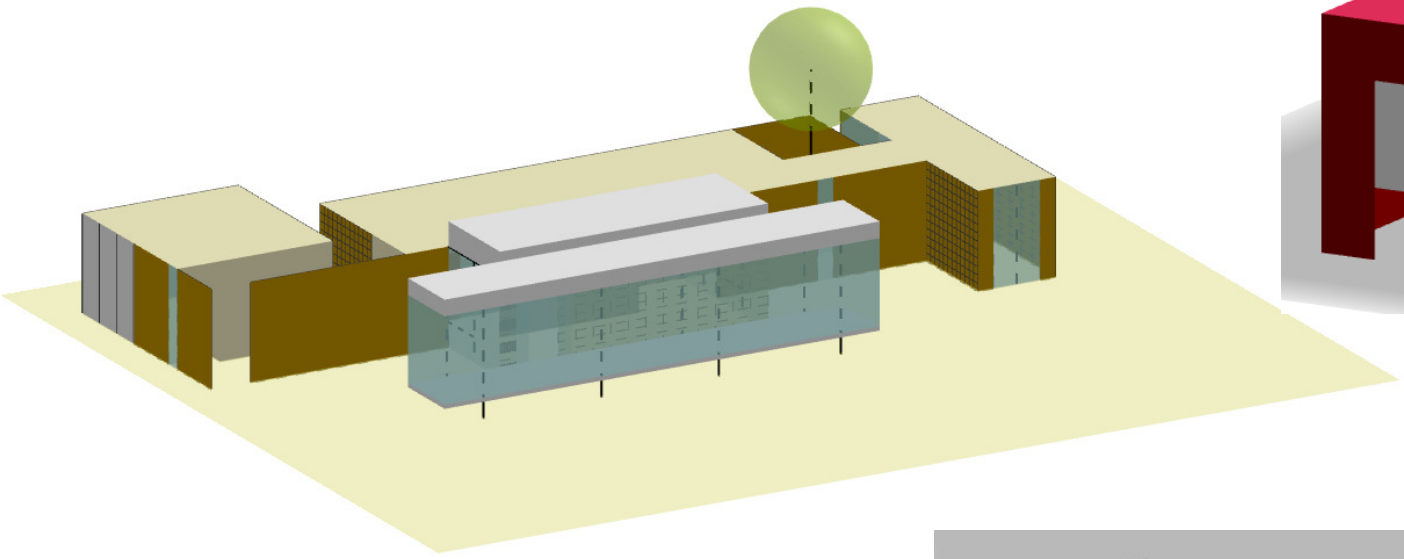
Cristian Camilo Manrique Espinosa
Curso 2015-2016

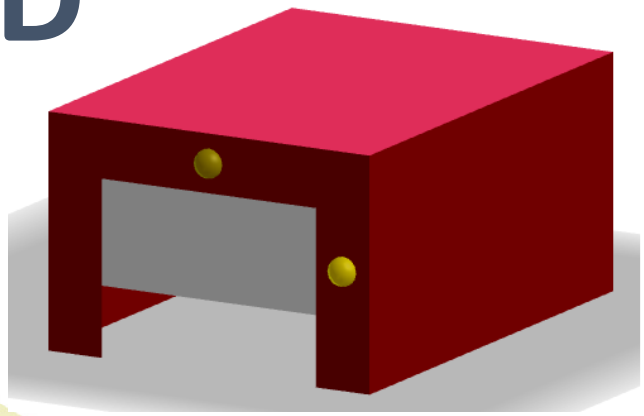
GOLDEN GATE (1930's)
San Francisco

Modelado 3D

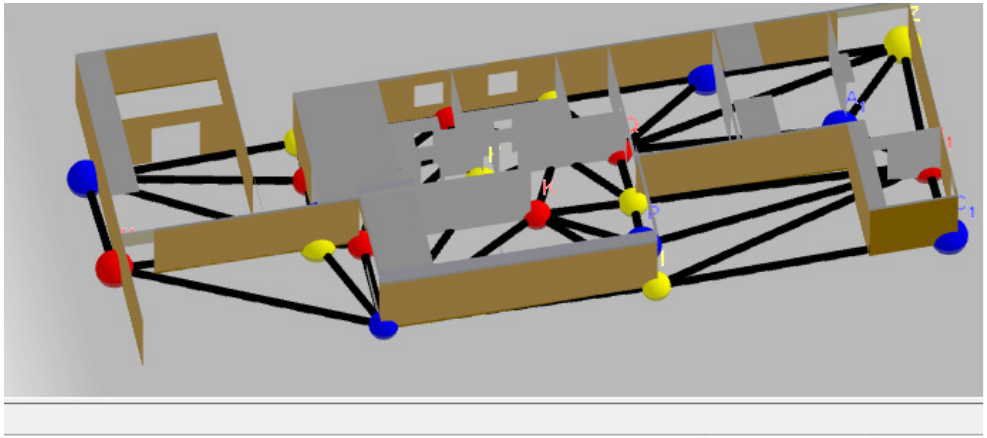
Javier Caro Rueda
Curso 2015-2016

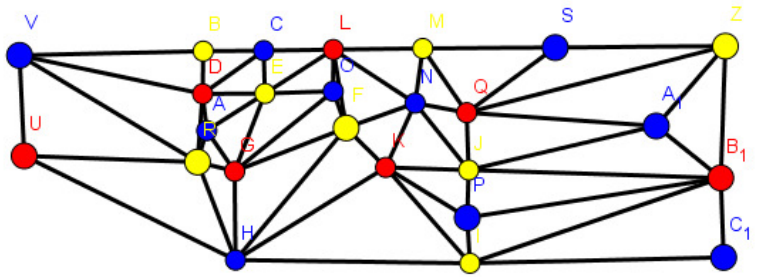
Modelado 3D





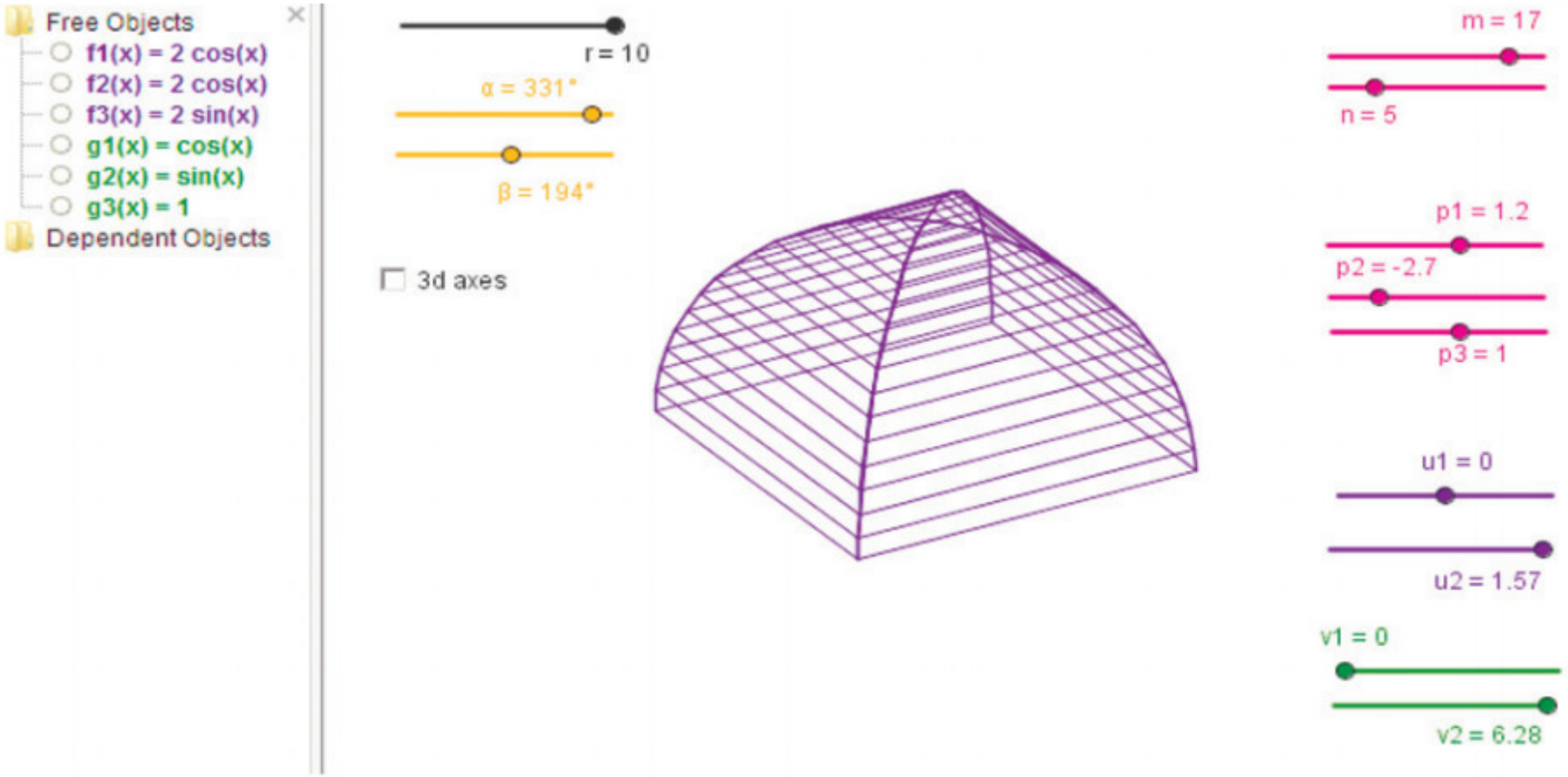
Marta Colón Paniagua
Curso 2016-2017



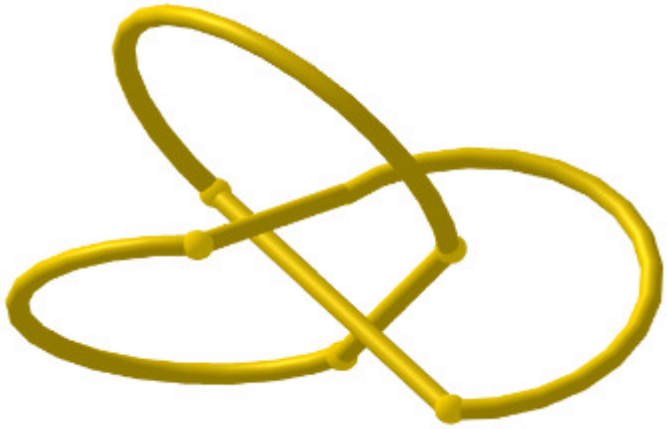


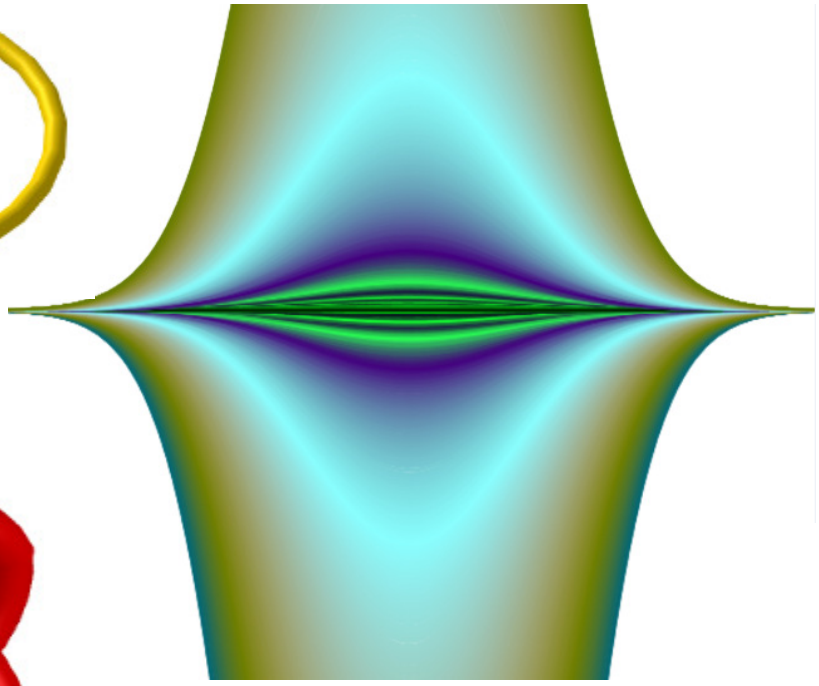
Nieves Torres Moreno
Curso 2016-2017

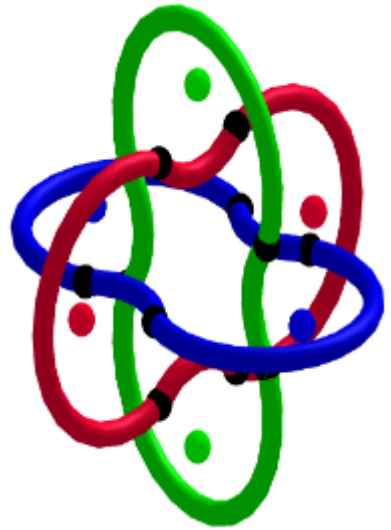
Modelado 3D

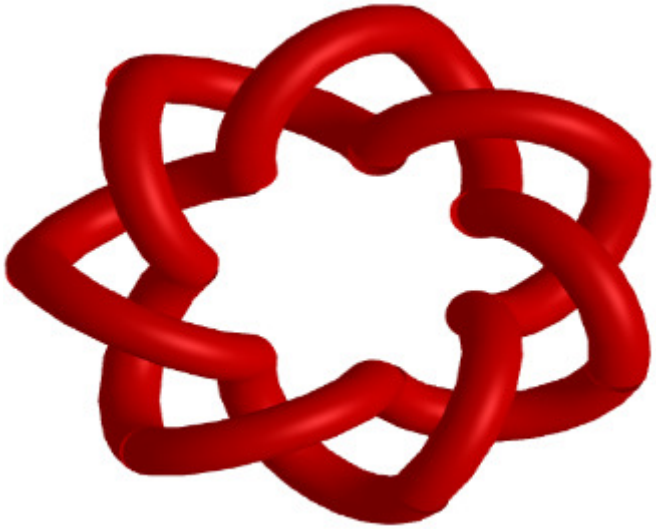

Free Objects
f1(x) = 2 cos(x)
f2(x) = 2 cos(x)
f3(x) = 2 sin(x)
g1(x) = cos(x)
g2(x) = sin(x)
g3(x) = 1
Dependent Objects
r = 10
α = 331°
β = 194°
3d axes
m = 17
n = 5
p1 = 1.2
p2 = -2.7
p3 = 1
u1 = 0
u2 = 1.57
v1 = 0
v2 = 6.28

Diseños basados en EDO's y Geometría Diferencial

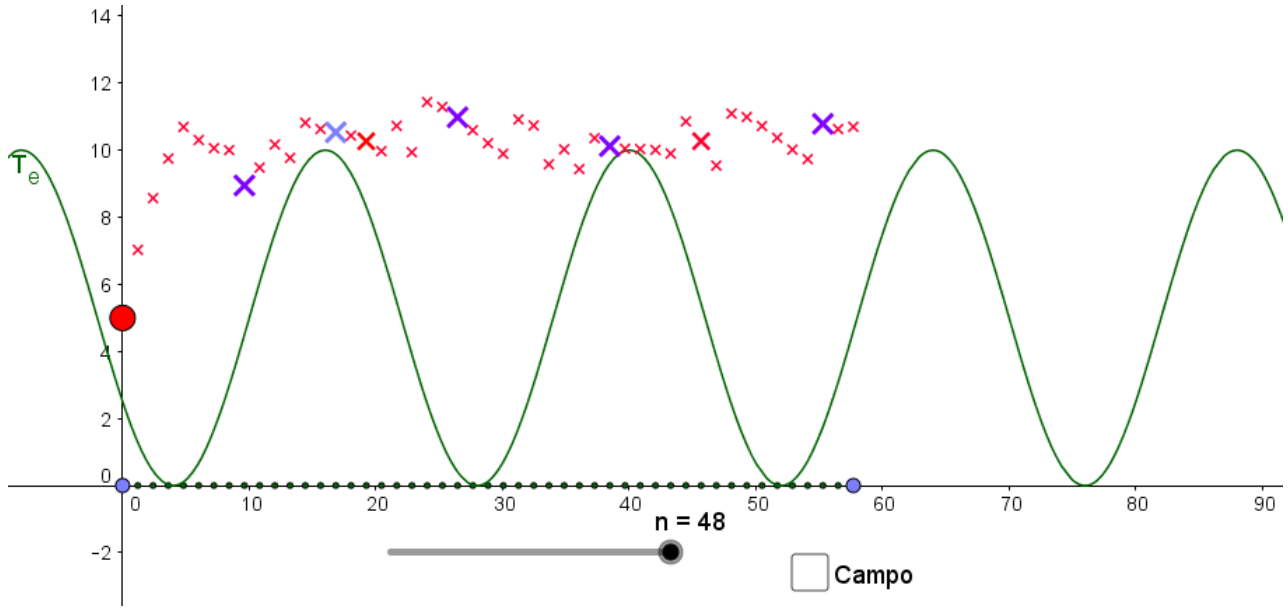


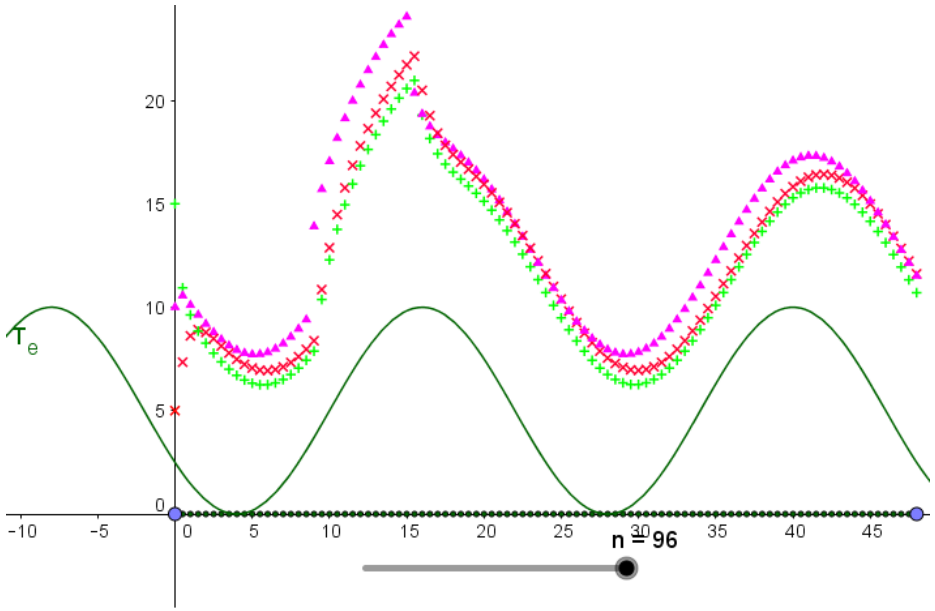




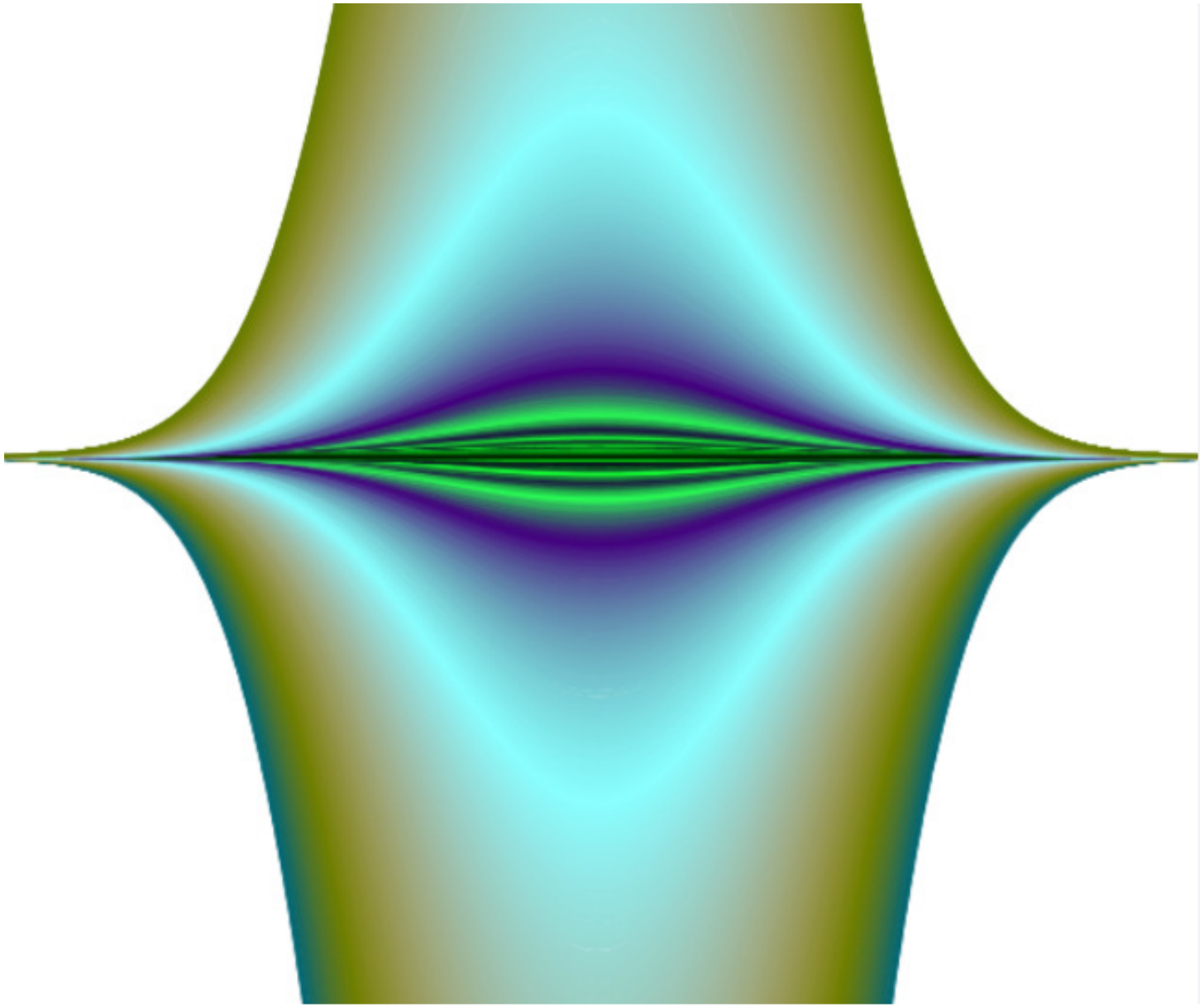


EDO’s

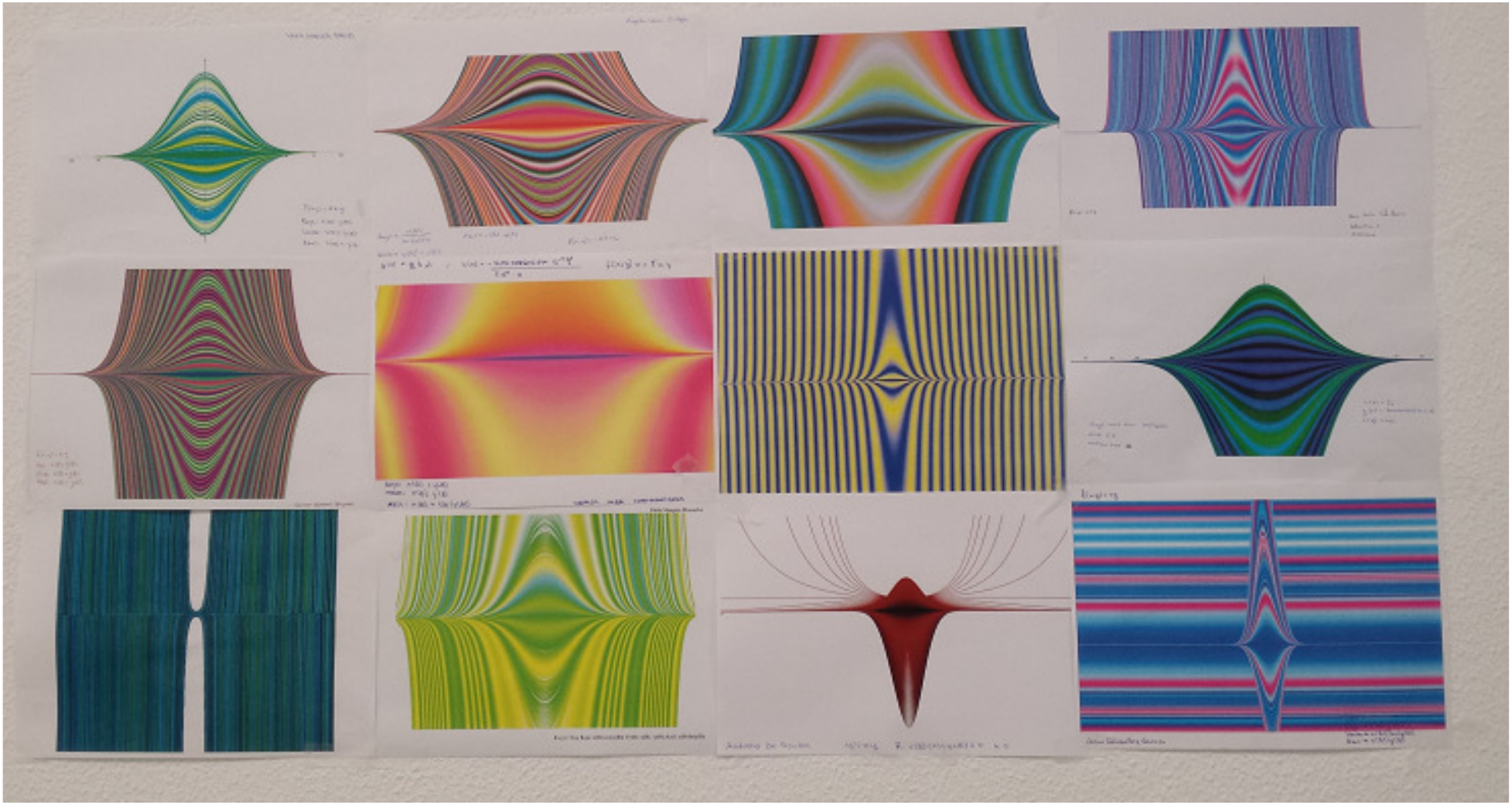

14
12
10
8
6
4
2
0
-2
T_e
0
10
20
30
40
50
60
70
80
90
n = 48
Campo


20
15
10
5
0
T_e
-10
-5
0
5
10
15
20
25
30
35
40
45
n = 96

EDO’s

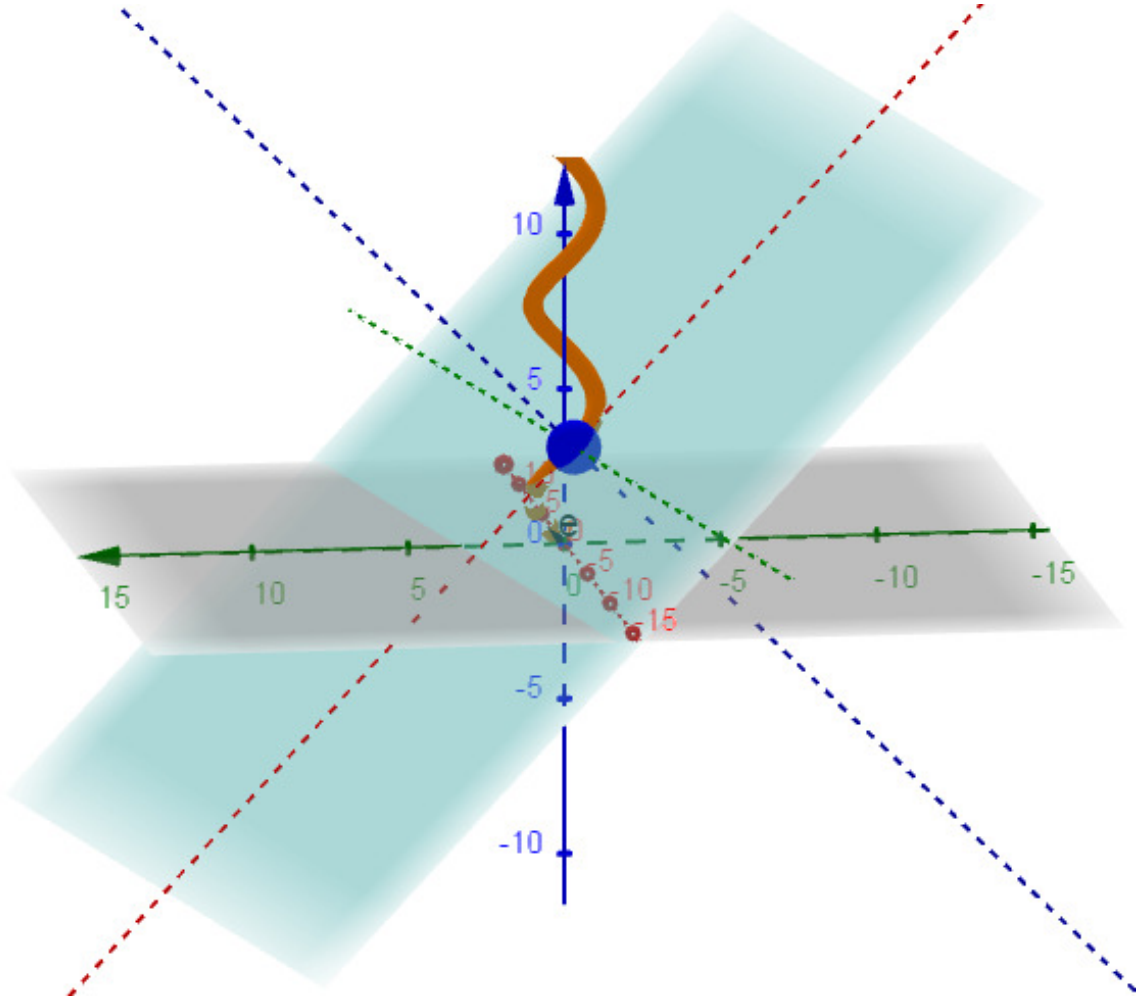


EDO’s

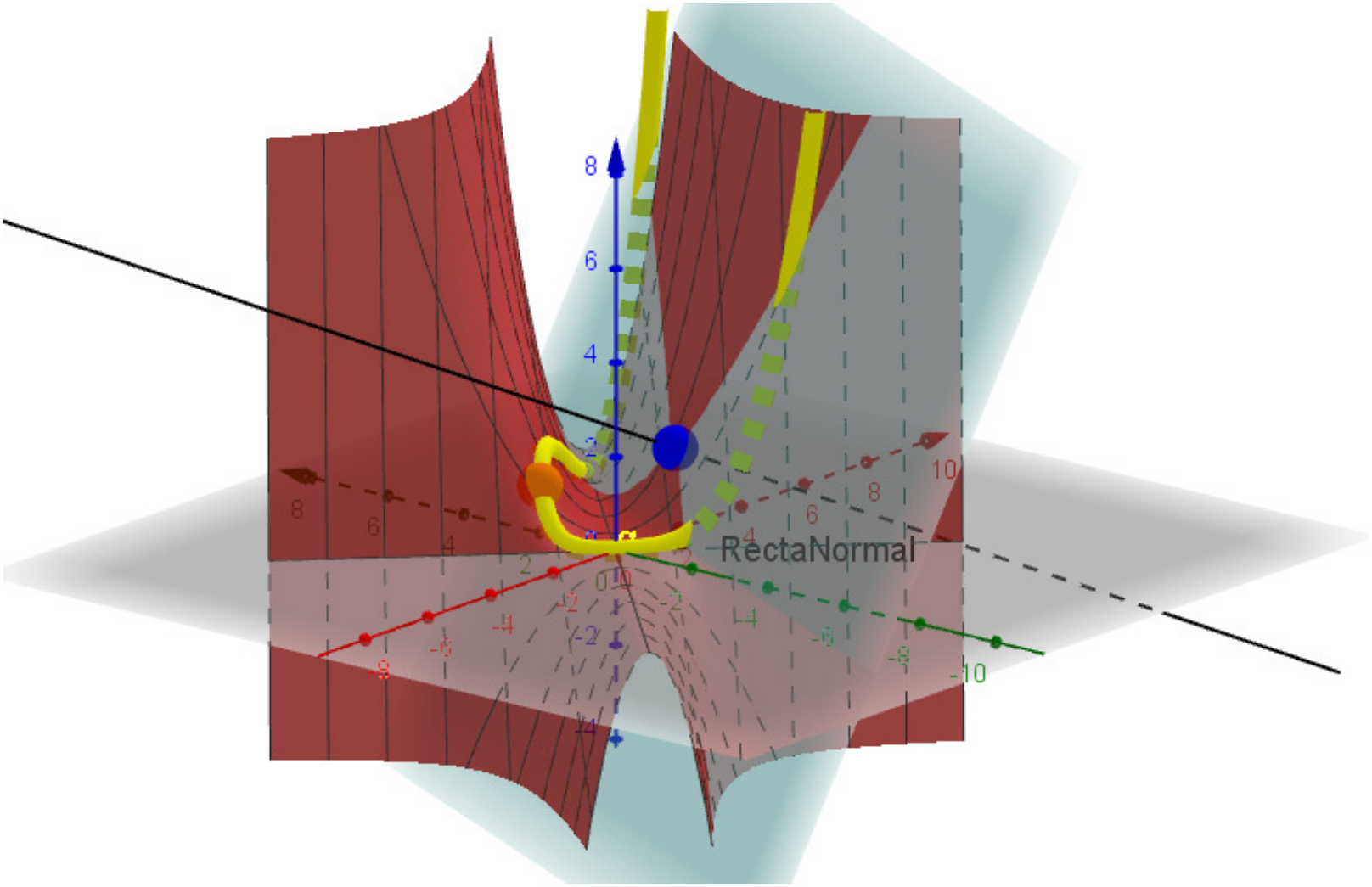



SEROID-CAMPOS MARTINEZ

Geometría Diferencial: Curvas.

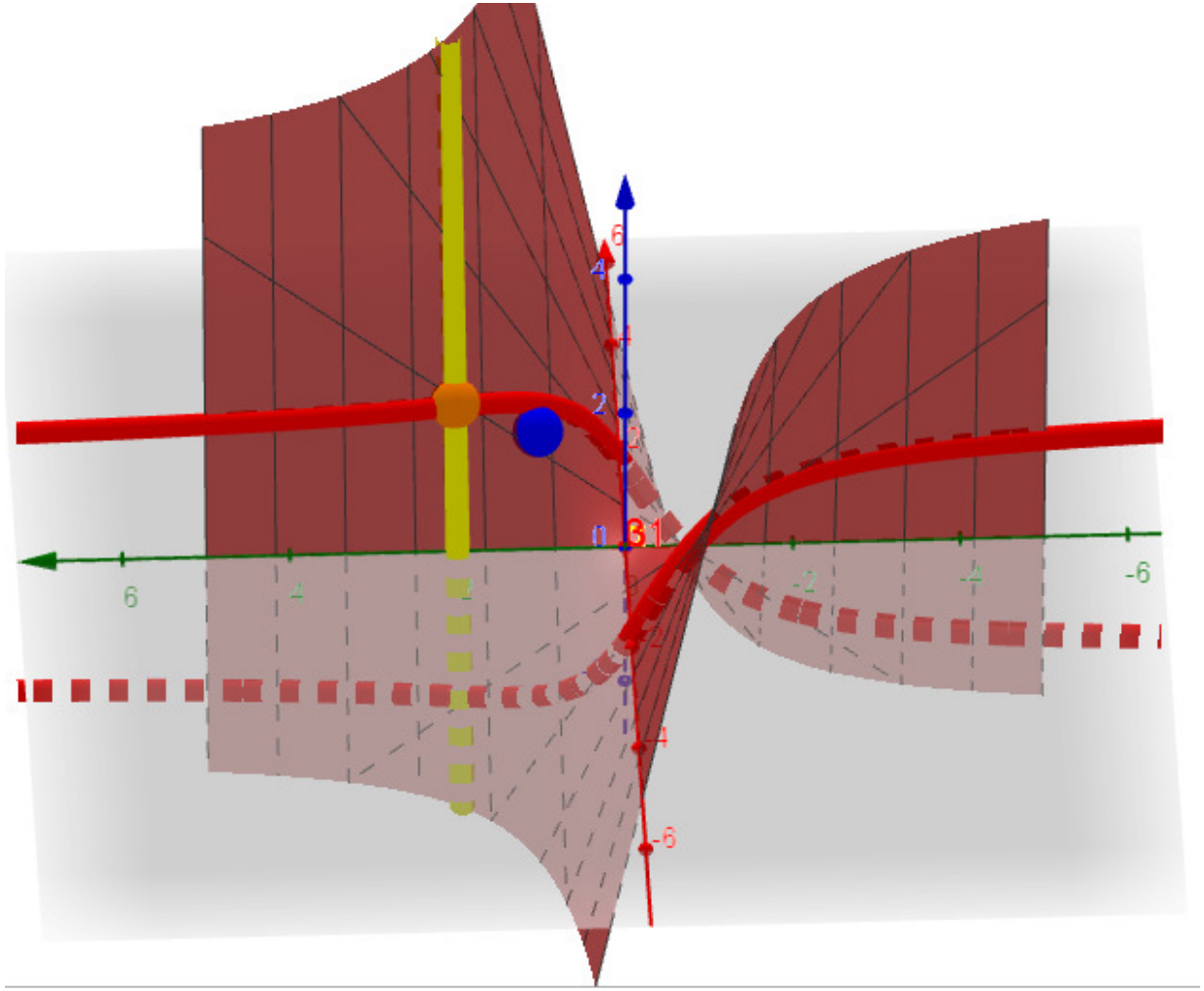


Geometría Diferencial: Superficies.

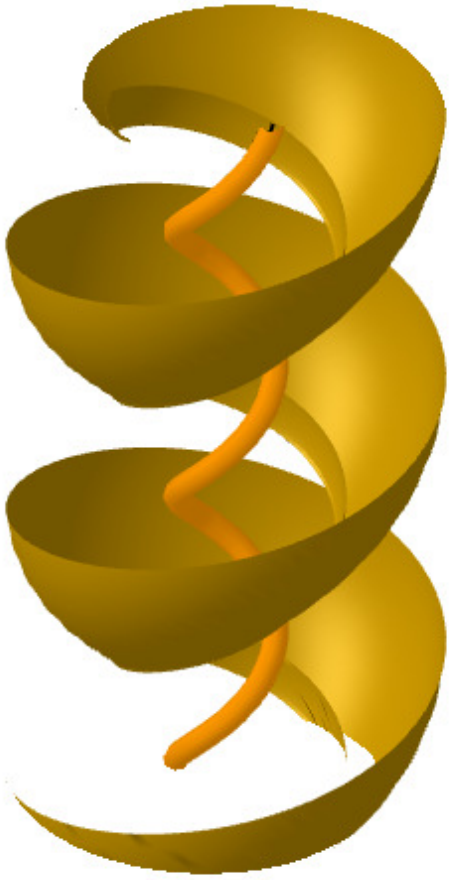


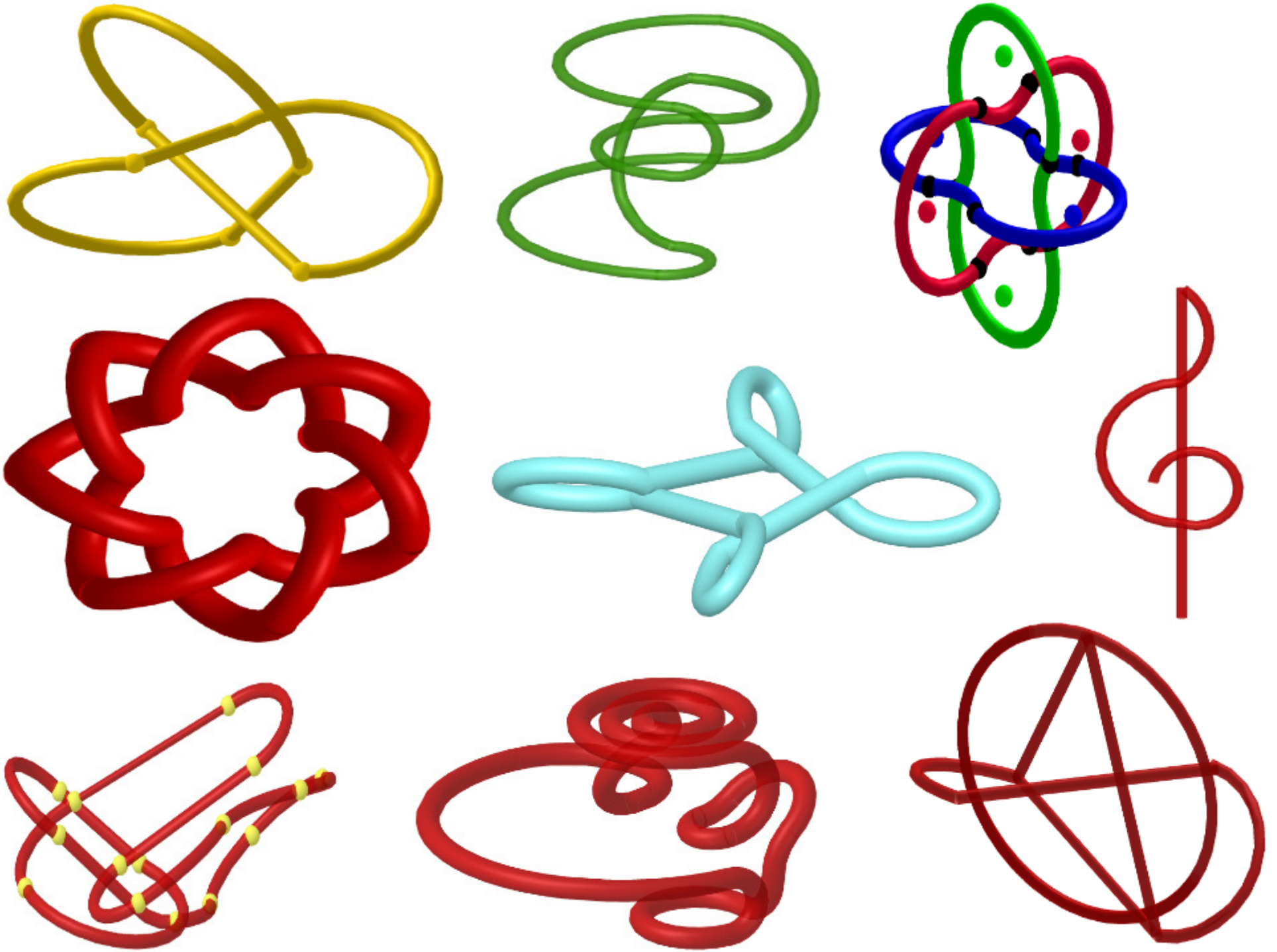
Ejercicio 5.9 *Consideramos el paraboloide hiperbólico* $\overrightarrow{r} = (u, v, uv)$ *y el punto* $P(1, 1, 1)$. *Hallar*

1. *el ángulo que forman las curvas coordenadas al cortarse.*
2. *el ángulo que forman las curvas* $uv = u^2 + v - 1$ *y* $3v^2 = 2u^3 + 1$ *en* P.
3. *las trayectorias ortogonales a la familia* $v = C$. *Particularizar en* P.
4. *las líneas de máxima pendiente.*



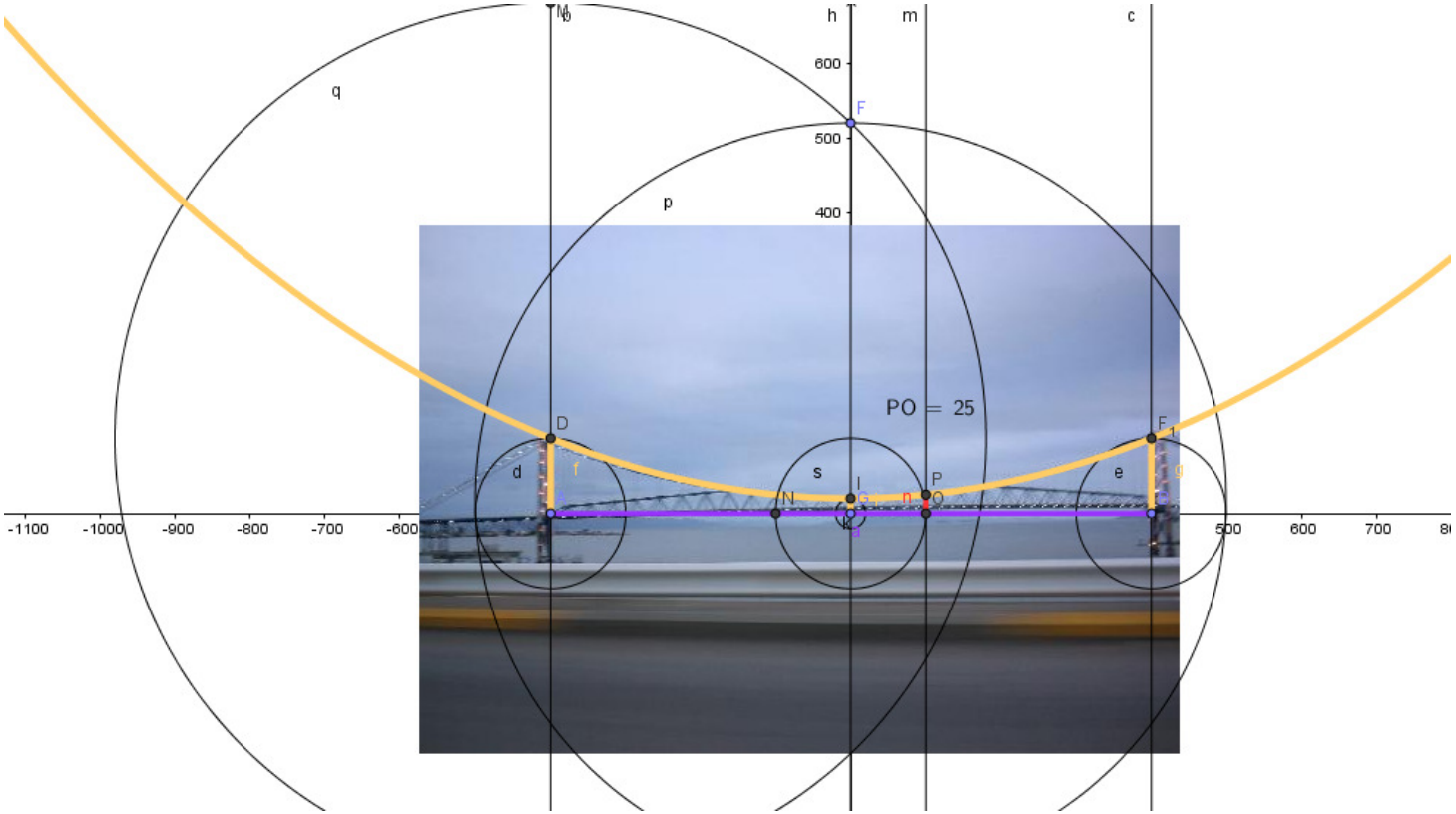
Geometría Diferencial: Superficies tubulares.





Extra: Estudio de cónicas.

Ejercicio 1.4 *El cable de suspensión de un puente tiene forma parabólica. La carretera es horizontal. Su longitud es 800 m. y está suspendido por tirantes verticales que unen el cable principal. Los dos tirantes verticales más largos miden 100 m. y el más corto mide 20m. Obtener la longitud de un tirante vertical unido a la carretera a una distancia de 100 m. desde el centro.*



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Gracias!!

GeoGebra, un primer paso para diseñar la Arquitectura Dinámica del Siglo XXI

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V Encuentro en Andalucía GeoGebra en el aula

Málaga, 22 de abril de 2017