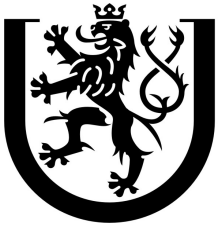

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A Gentle Introduction to Geometric Modelling via Dynamic Geometry

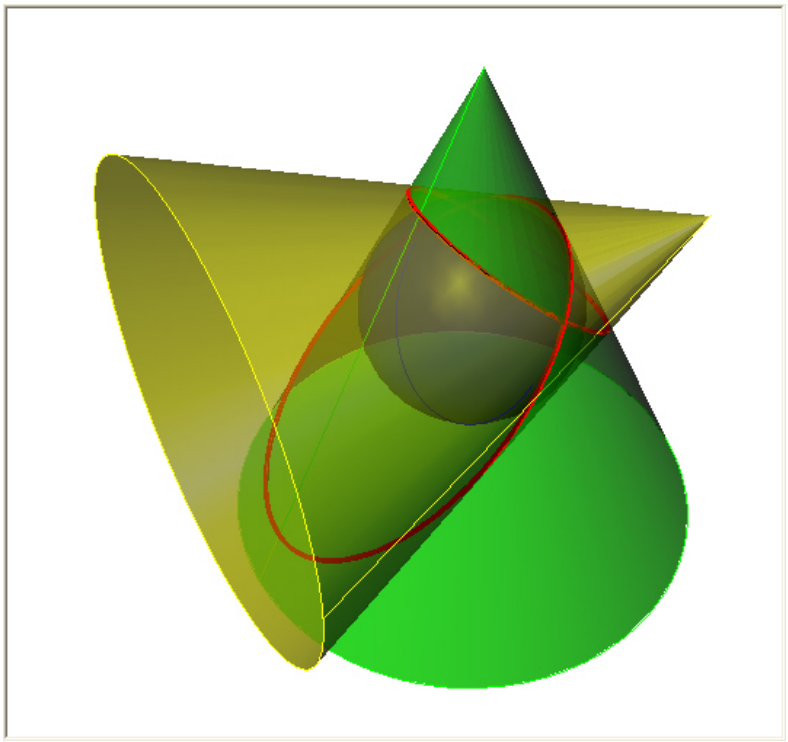
Světlana Tomiczková, Miroslav Lávička

KMA FAV ZČU Plzeň

2010

CADGME 2010

Content

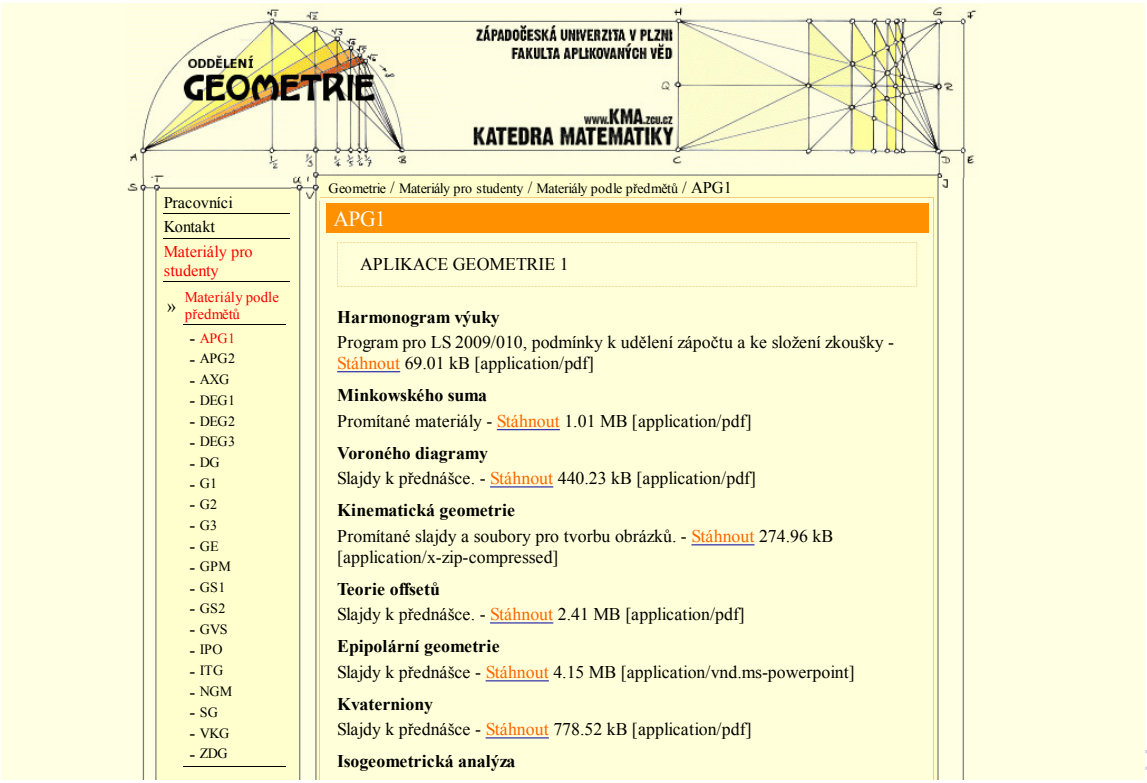


- Courses of Geometry, Tools of dynamic geometry
- Typical tasks for demonstration via dynamic geometry
  - Modelling of curves (de Casteljau, de Boor algorithms)
  - Modelling of surfaces and typical problems (surfaces of revolution, intersection of surfaces, helicoidal surfaces, envelope surfaces)

Courses of Geometry

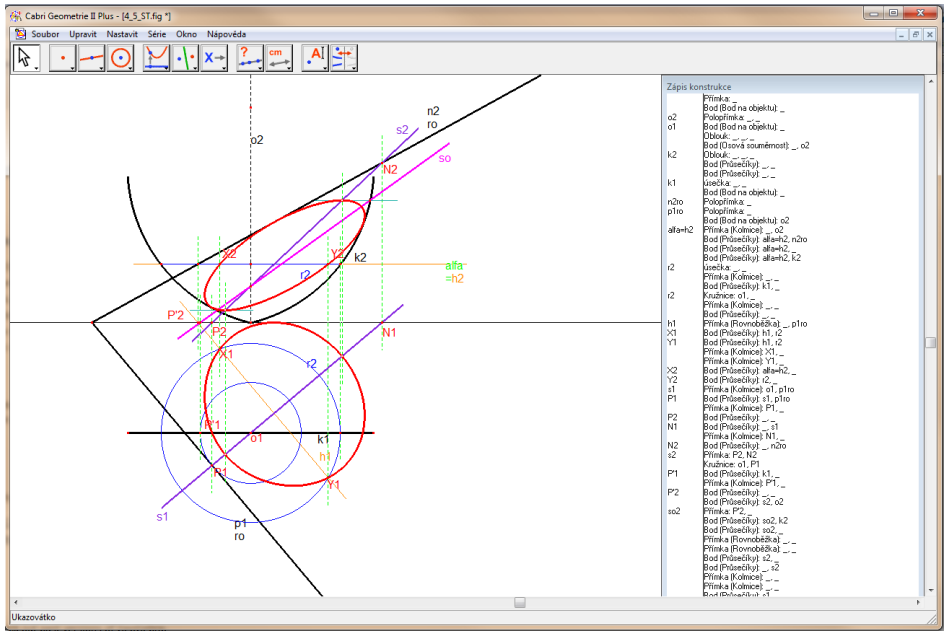
- Mathematics for six faculties or institutes
- 19 courses of geometry
- Modernisation and increasing of electronic support
- http://geometrie.kma.zcu.cz/

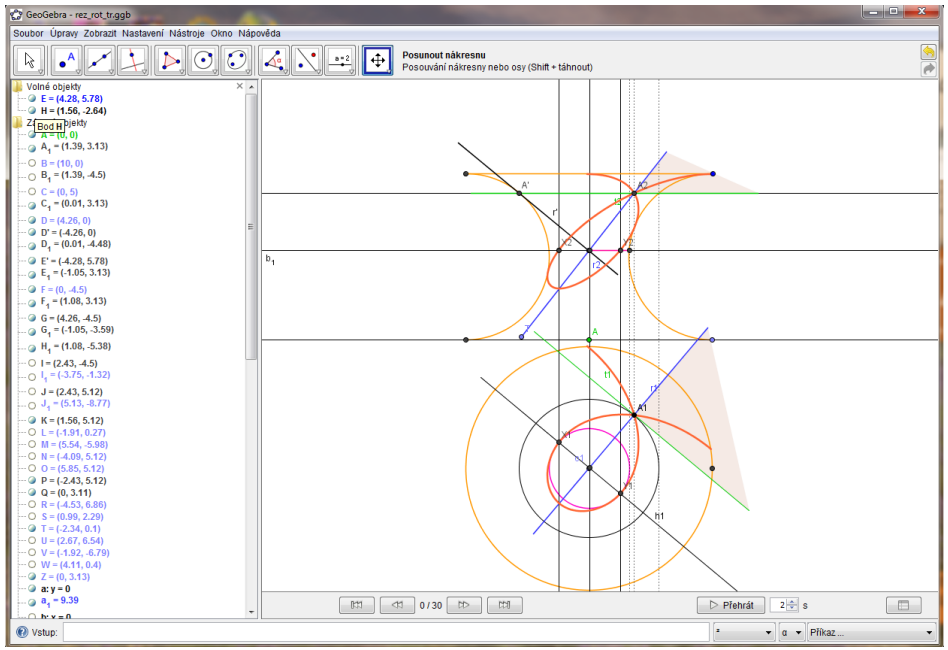
Oddělení Geometrie - Katedra matematiky ZČU http://geometrie.kma.zcu.cz/index.php/www/content/view/full/279/



Tools of Dynamic Geometry

Cabri, Sketchpad, Cinderella, GeoGebra, Mathematica, Maple, RhinoCeros, ...

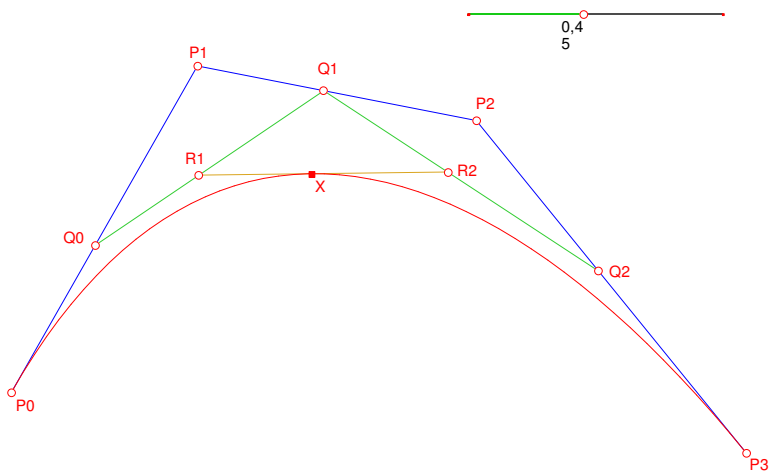




Modelling of Bézier Curves

The de Casteljau Algorithm

method for evaluating the point on a Bézier and rational Bézier curve corresponding to the parameter value $t \in \langle 0, 1 \rangle$



Bézier curve given by four control points P_0, P_1, P_2, P_3

- Linear interpolation to obtain three new points

$$Q_0(t) = (1-t)P_0 + t\,P_1$$
$$Q_1(t) = (1-t)P_1 + t\,P_2$$
$$Q_2(t) = (1-t)P_2 + t\,P_3$$

- Linear interpolation to obtain two new points

$$R_0(t) = (1-t)Q_0 + t\,Q_1$$
$$R_1(t) = (1-t)Q_1 + t\,Q_2$$

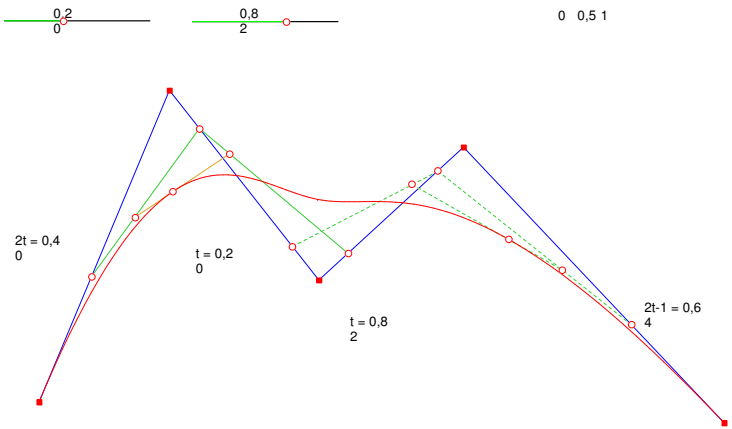
- Final calculation of the curve point

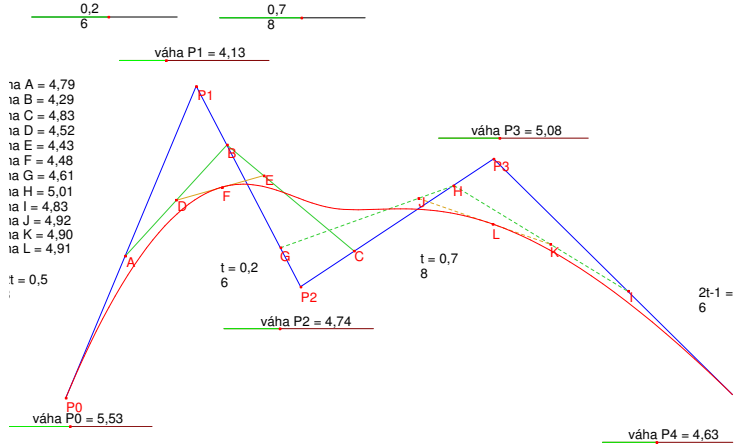
$$X(t) = (1-t)R_0 + t\,R_1$$

Modelling of Curves

The De Boor Algorithm

Evaluation of points on a B-spline curve and NURBS curve

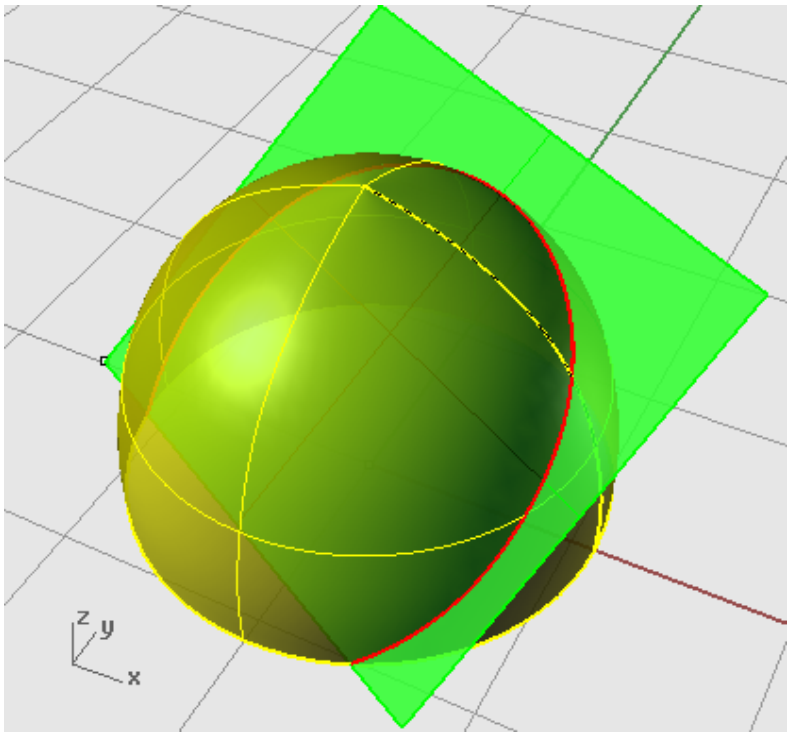




Surfaces of Revolution

Intersection of surface of revolution and plane

Construct the intersection of surface of revolution and plane σ

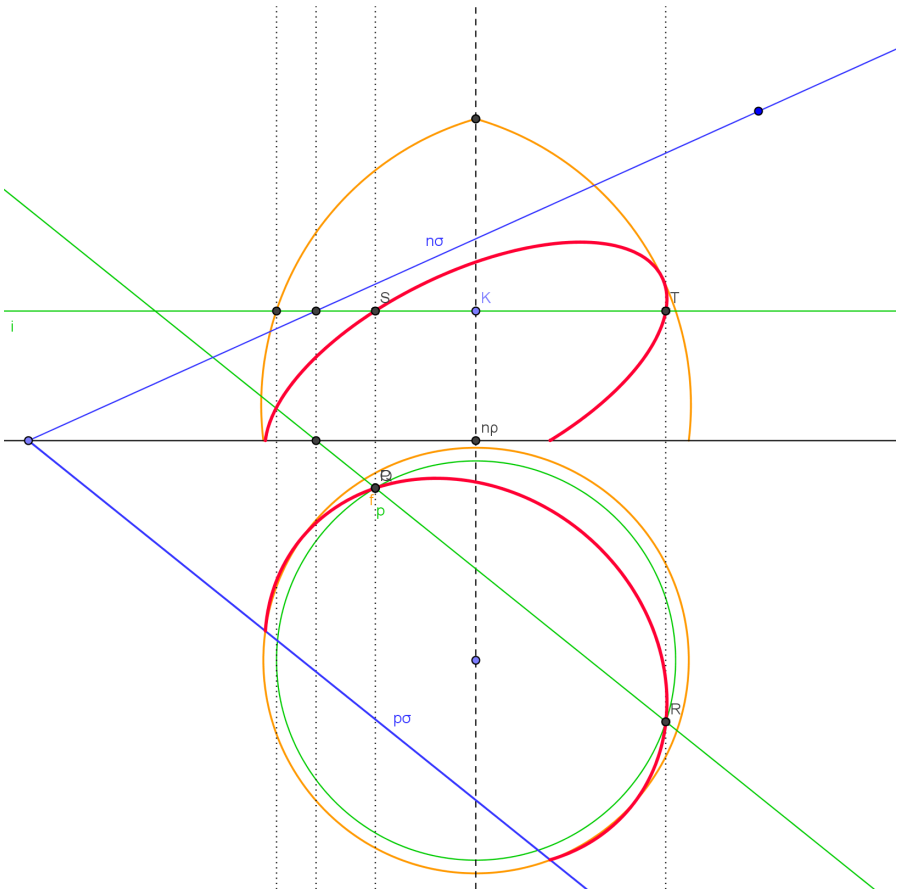


- choice of auxiliary plane α : $\alpha \parallel \pi$
- line h: the intersection of the plane α and σ
- circle $k(S, r)$: the intersection of the plane α and surface of revolution
- points X, Y: intersection of h and k
- choice of new plane α'

Surfaces of Revolution

Intersection of surface of revolution and plane

Construct the intersection of surface of revolution and plane σ



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- circle $k(S, r)$: the intersection of the plane α and surface of revolution
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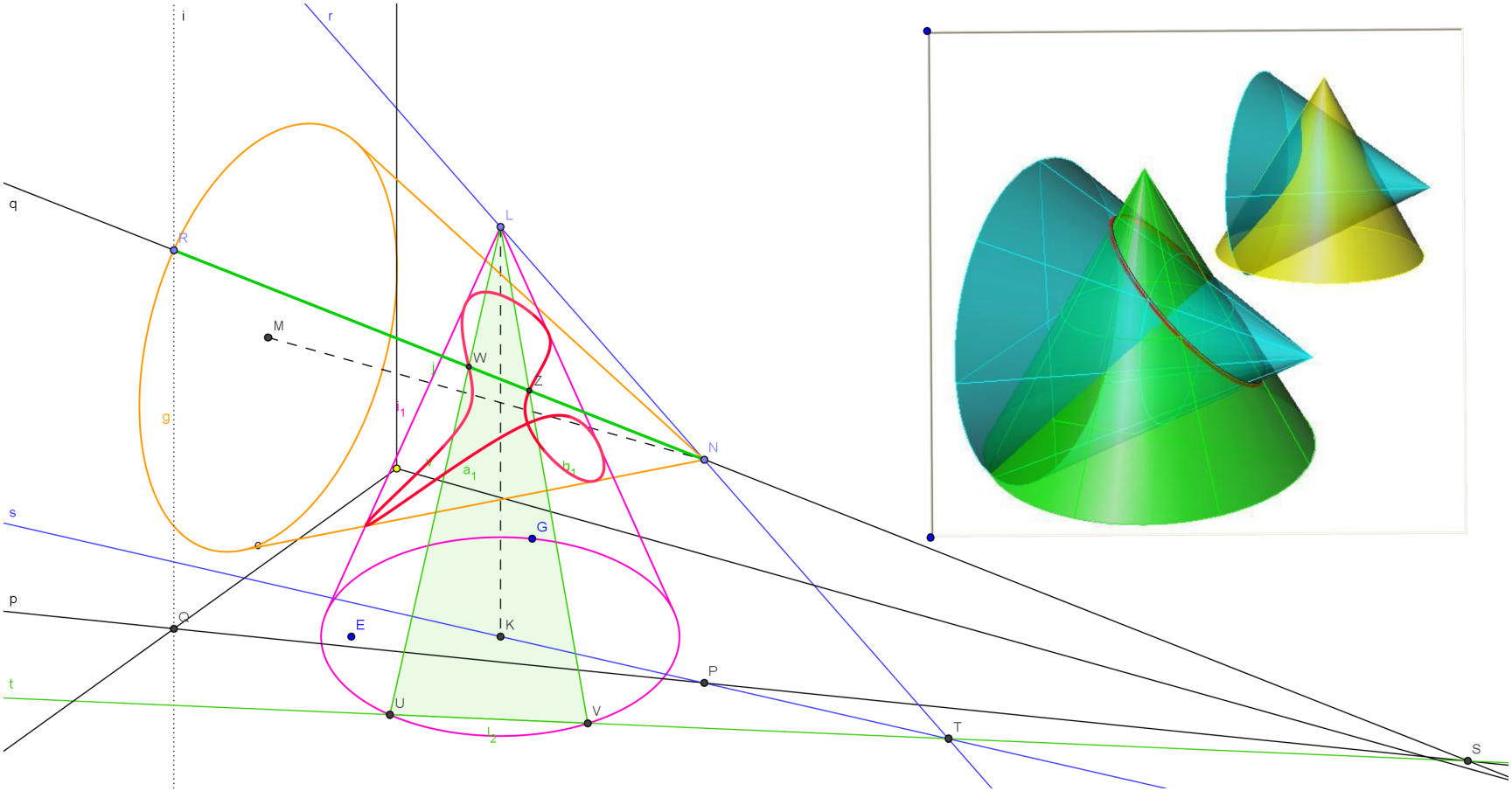
Intersectin of Elementary Surfaces

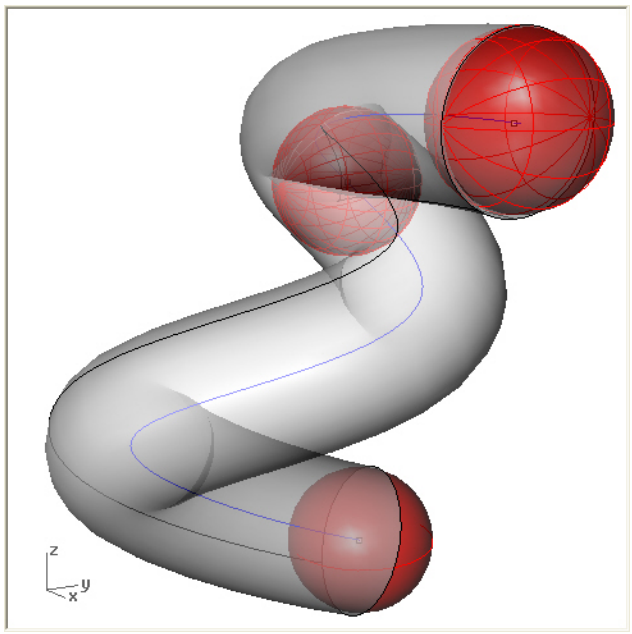
Intersection curve of two cones

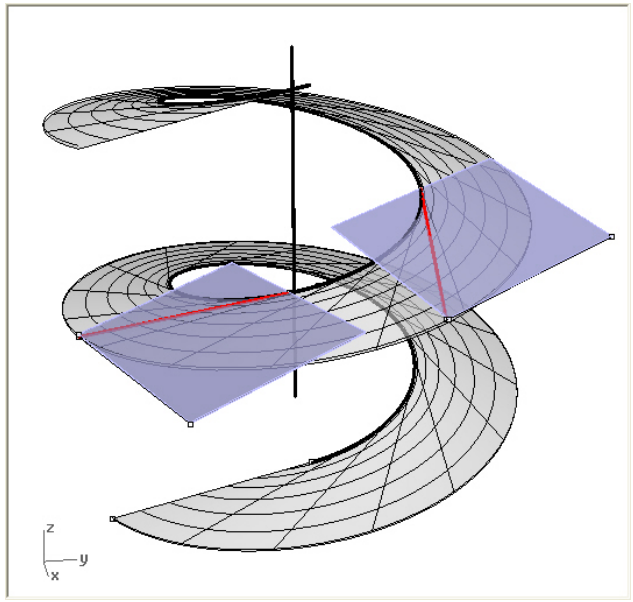


Envelope Surfaces

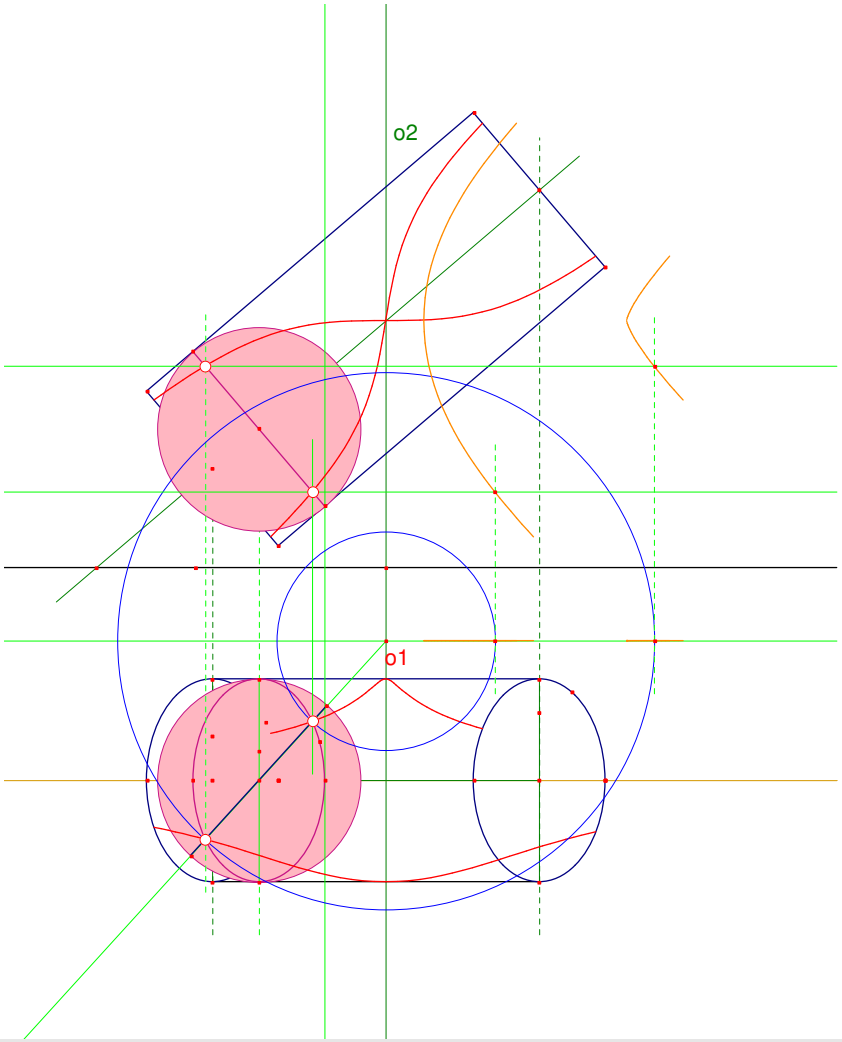
The characteristic curve

Let us a one-parametric system $\kappa(t)$ of surfaces. Envelope surface of this system is the surface which contacts every surface of $\kappa(t)$ along a curve $k(t)$. This contact curve is called the characteristic curve of the system.



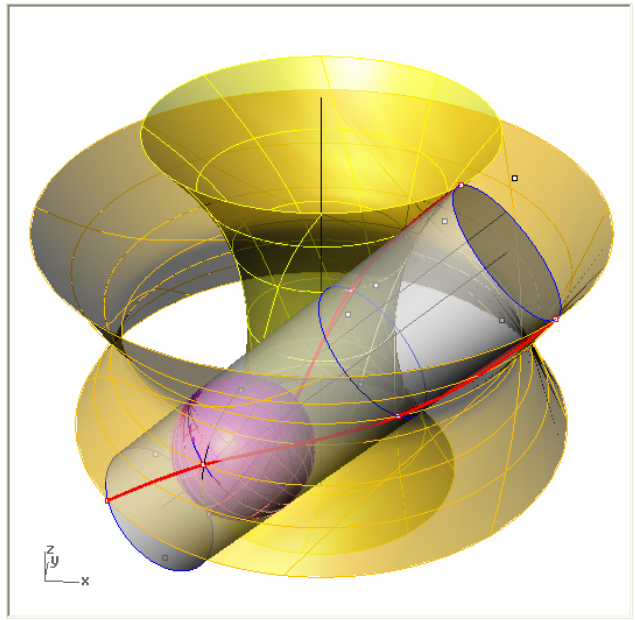


Envelope Surfaces generated by revolution of a surface of revolution



The characteristic curve

- Construction of auxiliary sphere κ which contacts κ along k.
- Construction of characteristic curve c of the sphere κ.
- Intersection points $X = k \cap c$.
- Construction of new auxiliary sphere.



Thank you for your attention