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# VISUALIZATION OF SECOND DEGREE SURFACES

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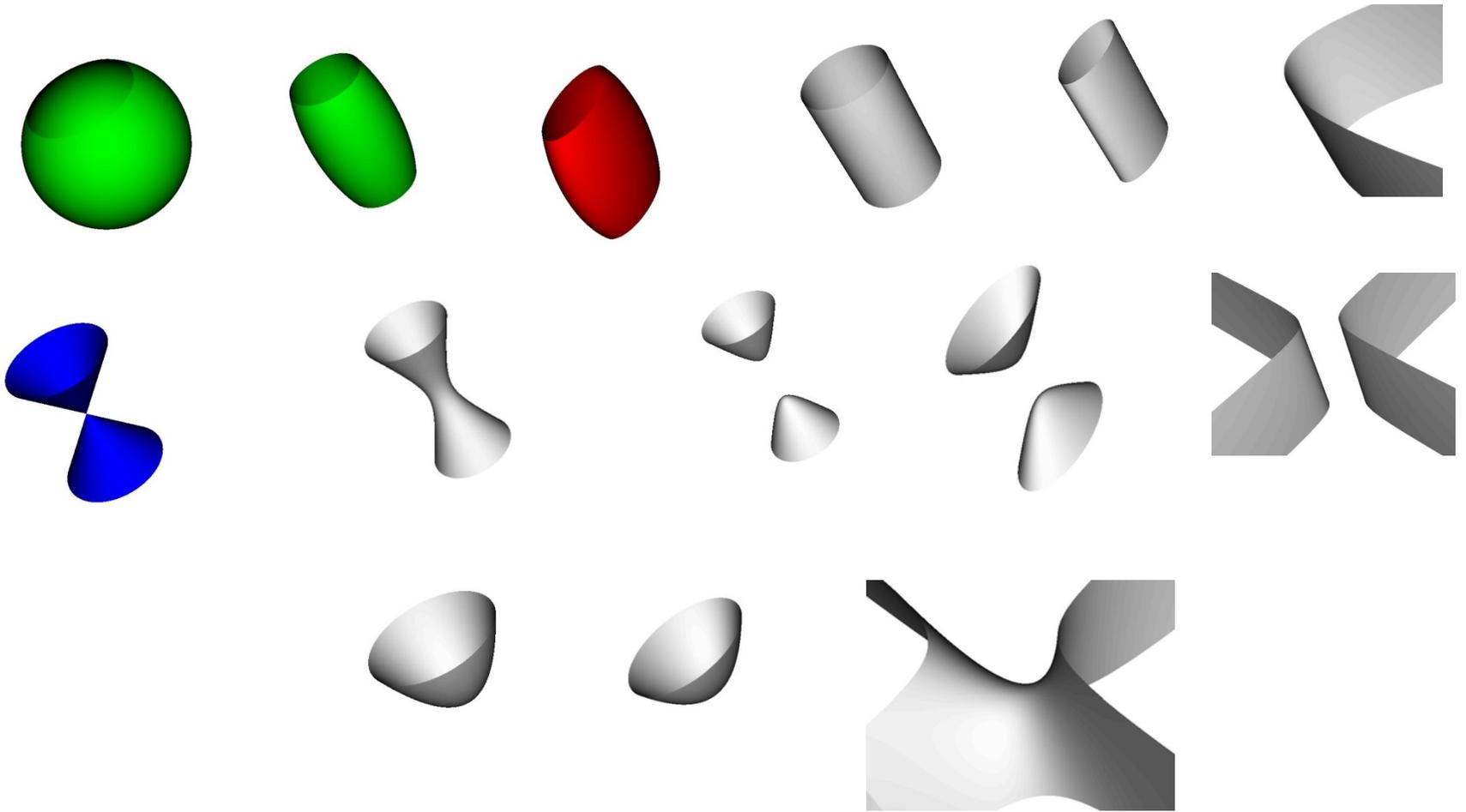
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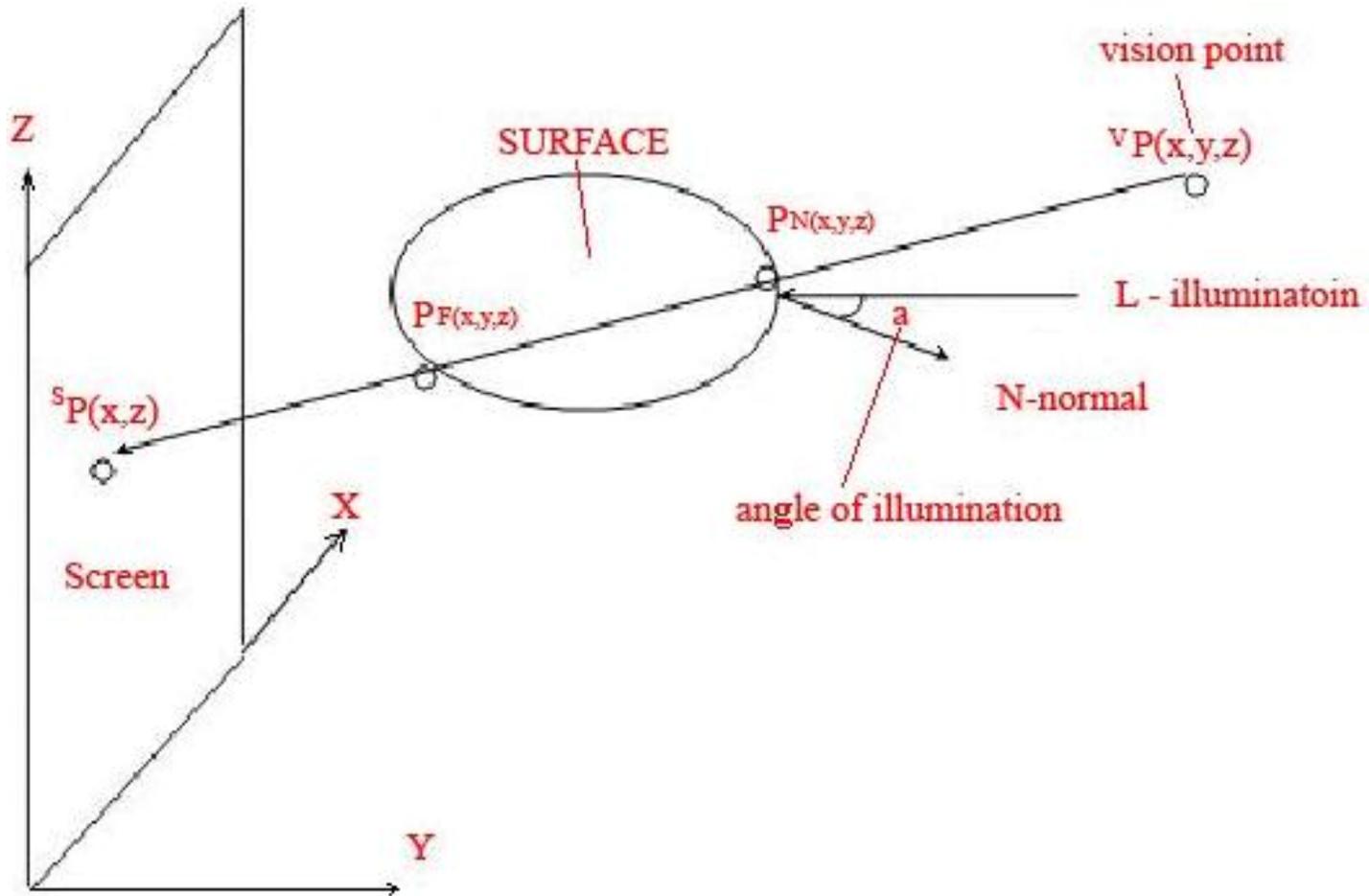
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# Surfaces of the 2<sup>nd</sup> degrees



# Shined surfaces painting method



Surface points displaying to the screen

# Mathematical description of a method

We visualize a surface of 2-nd order which equation looks like

$$A9x^2+A8y^2+A7z^2+A6xy+A5xz+A4yz+A3x+A2y+A1z+A0=0 \quad (0)$$

The equation of the direct line lead through two points in space looks like

$$x - x1/(x2-x1)= y - y1/(y2-y1)= z - z1/(z2-z1) \quad (1)$$

Let's accept current values:

- pixel on the screen : Xsp –on width and Zsp – on height
- point laying on the surface: Xp – on width of volume. Yp – on depth of volume. Zp – on height of volume

In the equation (2) we shall substitute xSP and we shall express xP through yP

$$xP = (yP-yVP)(xSP- xVP)/yVP + xVP; \quad (2)$$

In the equation (41) we shall substitute zSP and we shall express zP through yP

$$zP = (yP-yVP)(zSP- zVP)/yVP + zVP. \quad (3)$$

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Let's solve system of the equations (0) - (1), having substituted expressions (2) and (3) in the equation (0) and having received, lowering bulky calculations, the equation rather  $y_P$

$$AP_2 y_P^2 + AP_1 y_P + AP_0 = 0, \quad (4)$$

Solve the equation (5) for a finding  $y_P$

- $y_{PN} = \mathbf{b} + \mathbf{q}$  Near point of a surface
- $y_{PF} = \mathbf{b} - \mathbf{q}$  a distant point of a surface

Substituting the calculated value  $y_P$  in (2) and (3) we shall calculate  $x_P$  and  $z_P$ .

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We calculate an angle between a normal of a surface in point N (x, y, z) and a direction of illumination L (x, y, z)

$$a = (x_L * x_N + y_L * y_N + z_L * z_N) / \sqrt{(x_L^2 + y_L^2 + z_L^2) * (x_N^2 + y_N^2 + z_N^2)}$$

Value a changes within the limits of from 0 up to 1. Number of a semitone of color hcol is defined under the formula

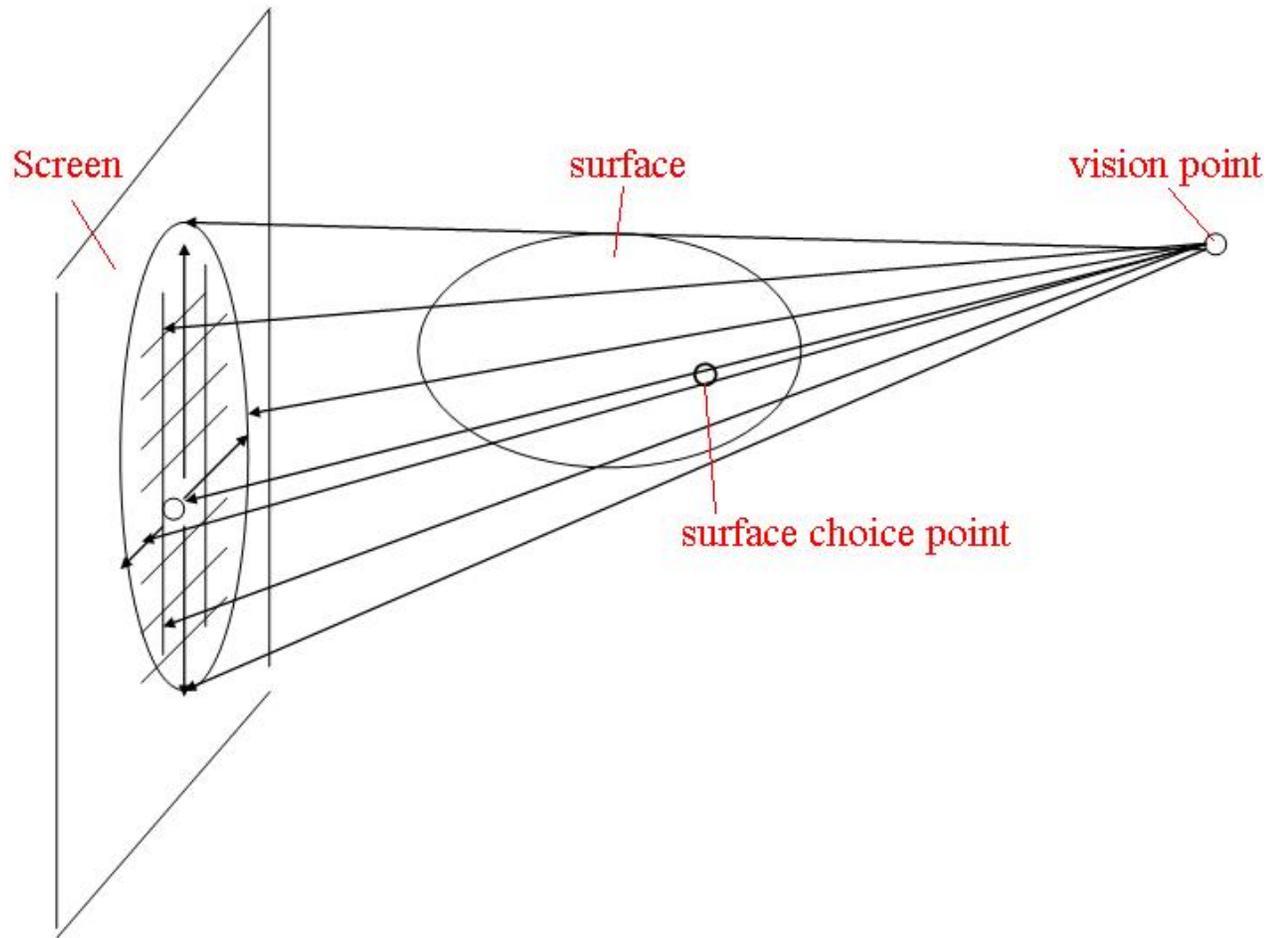
$$hcol = a * dcol + bcol$$

**dcol** Number of semitones of color

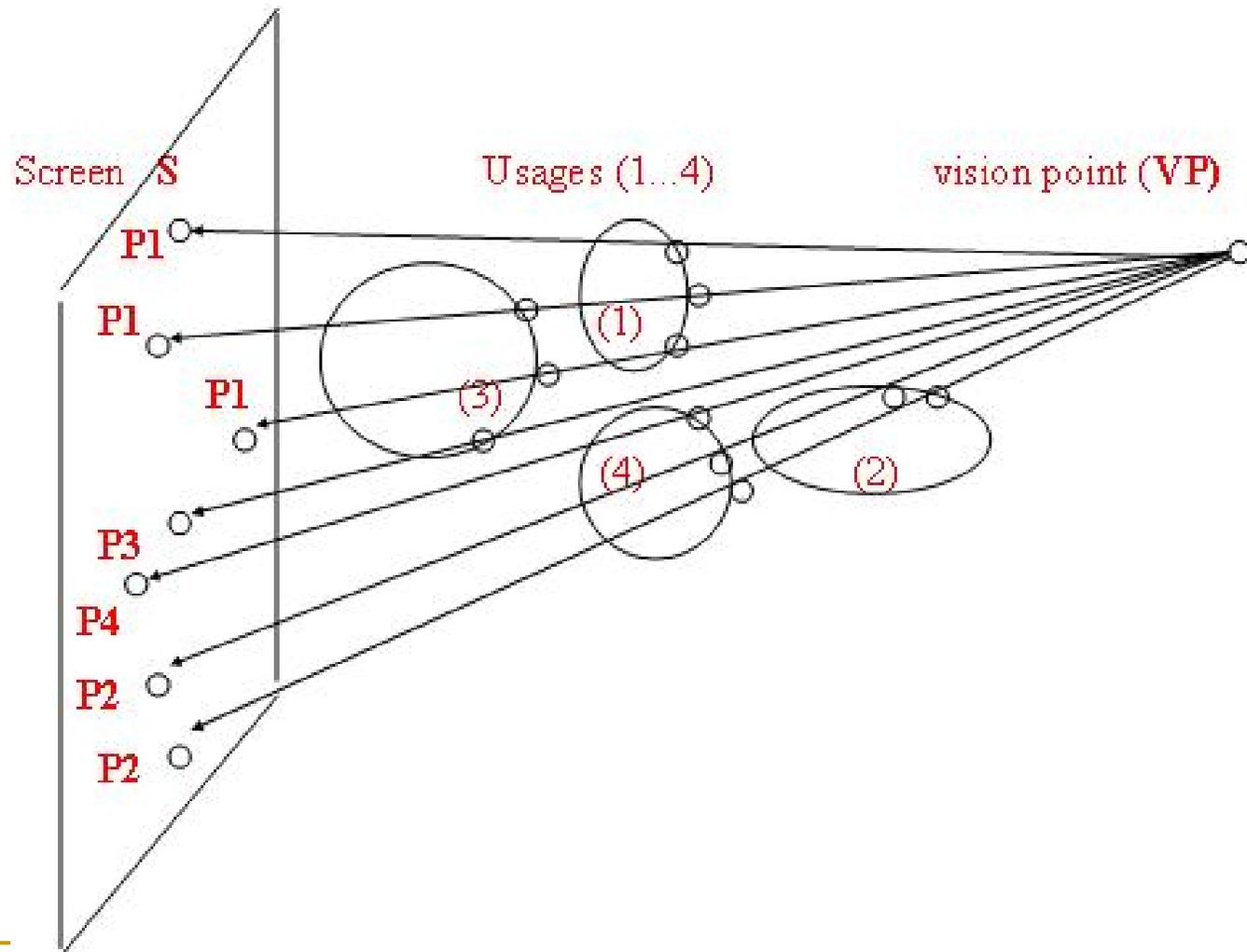
**bcol** Initial number of color in the color table.

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# The direction of scanning for minimization of number of passes



# Visibility definition method

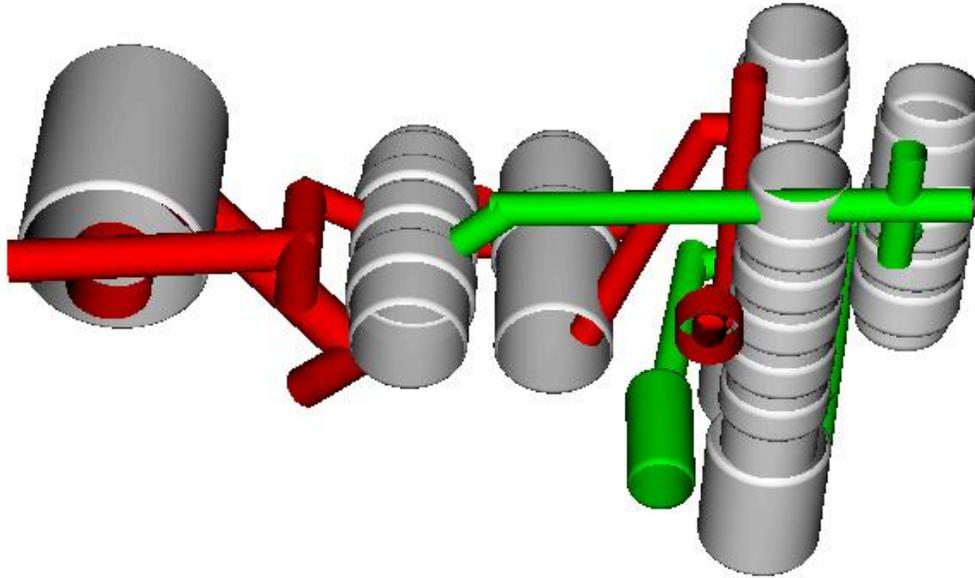


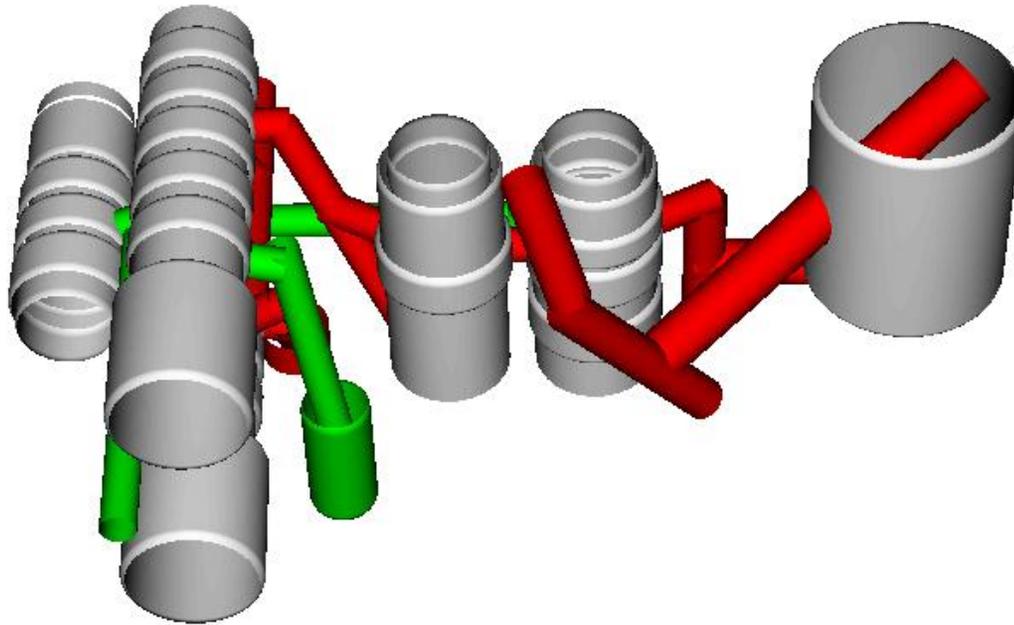
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# VISUALIZATION OF 3D-SCENES IN PRACTICAL SYSTEMS

- The automated system of flying vehicles landing in difficult conditions of visibility
  - 2. 3D models editor
  - 3. The computer stereo game "Flying spheres"
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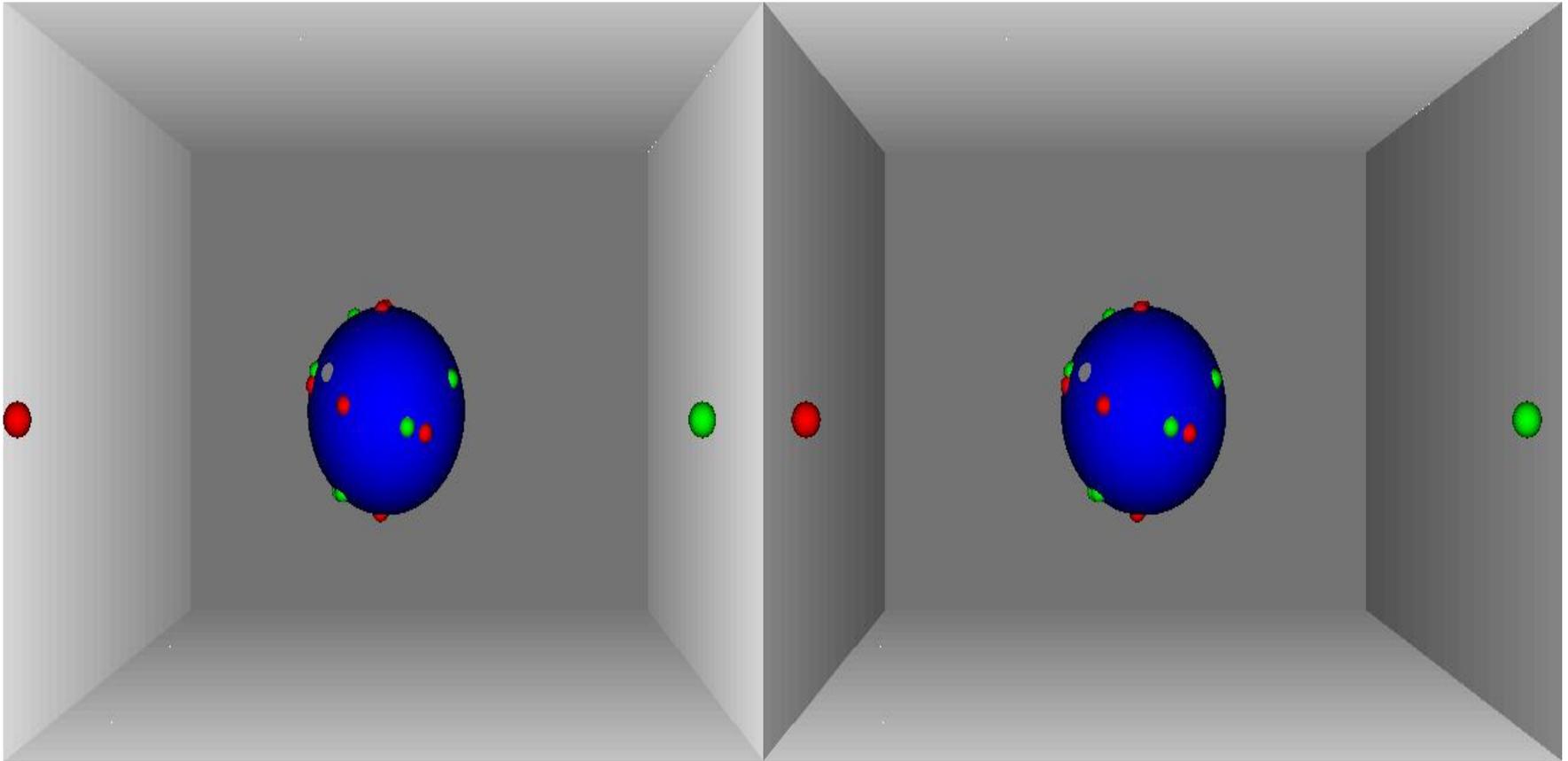
# Geometrical editor of hydrodynamical 3D models





- The designer, setting a structure and coordinates of hydraulic channels, receives their display to the screen.
- The form of channels displays both feature of a design, and technology of their manufacturing . The geometrical information further is used for mathematical modelling hydrodynamical processes.

# The computer stereo game "Flying Balls" - "FB"



The automated system of flying vehicles landing in difficult conditions of visibility

