How to design a bifilar sundial by means of the

Orologi Solari

program

www.sundials.eu

The design and construction of a generalized bifilar sundial, i.e. with wires anyway defined and oriented, is now within everyone's means with Orologi Solari rev. 30.0.

In bifilar sundials the gnomonic point is the intersection between the shadows of two wires.

In its original version, as invented by the Austrian gnomonist Michnik, only rectilinear wires were considered.
Later on the Spanish gnomonist Soler Gaya introduced catenaries and then parabola shaped wires.

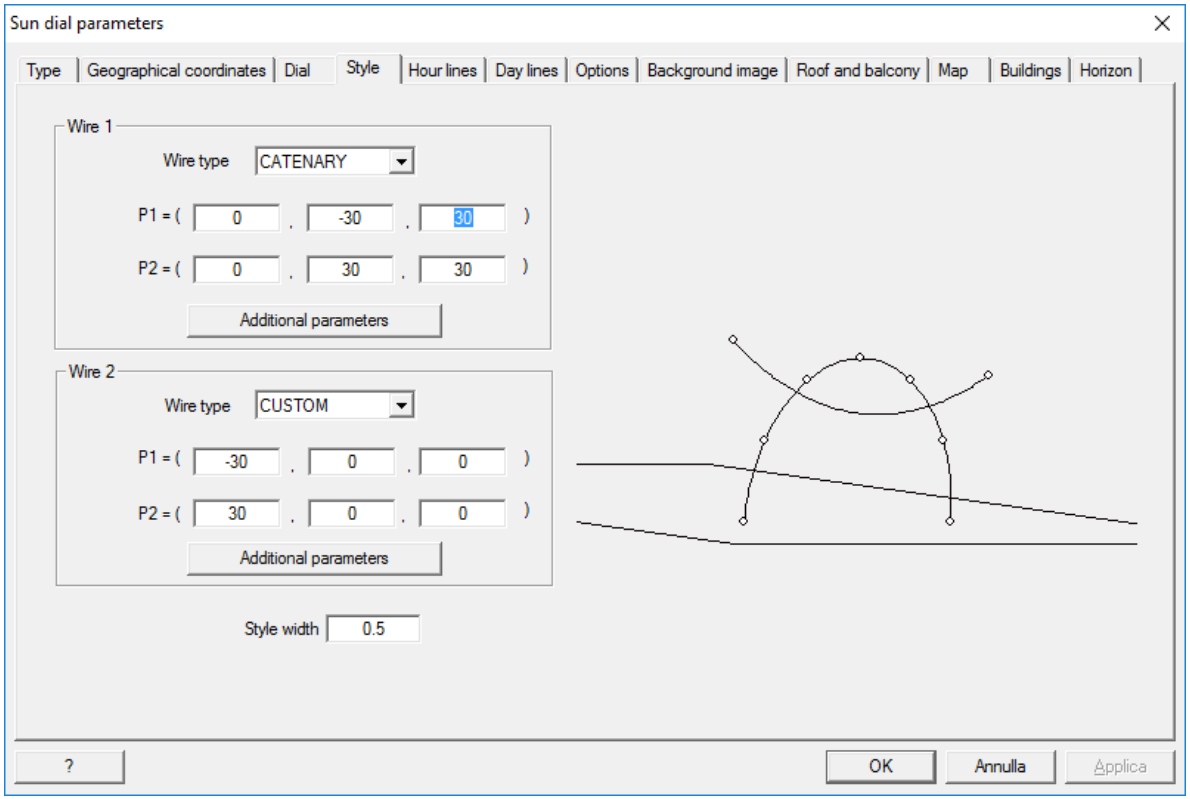
Orologi Solari program allows to choose two wires as a free arrangement of the following elements:

- linear wire (straight line that connects two points)
- catenary (curve that an idealized hanging chain or cable assumes under its own weight when supported only at its ends)
- custom wire (curve defined by means of a series of points in space connected by a B-Spline curve)

All Orologi Solari functionalities are applicable to bifilar sundials too.

This document shows the steps that are specially required for the design of these sundials. For other general settings please have a look at the other “How to…” documents.

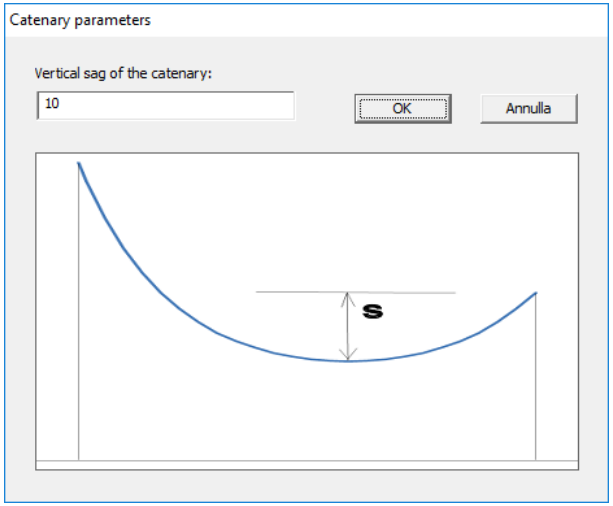
The two wires are defined in the «Style» window that is shown in the following picture:



Select the desired wire type from the combo box and insert the end points in the P1 and P2 fields. For catenaries and custom wires the button «Additional parameters» allows to introduce additional data.

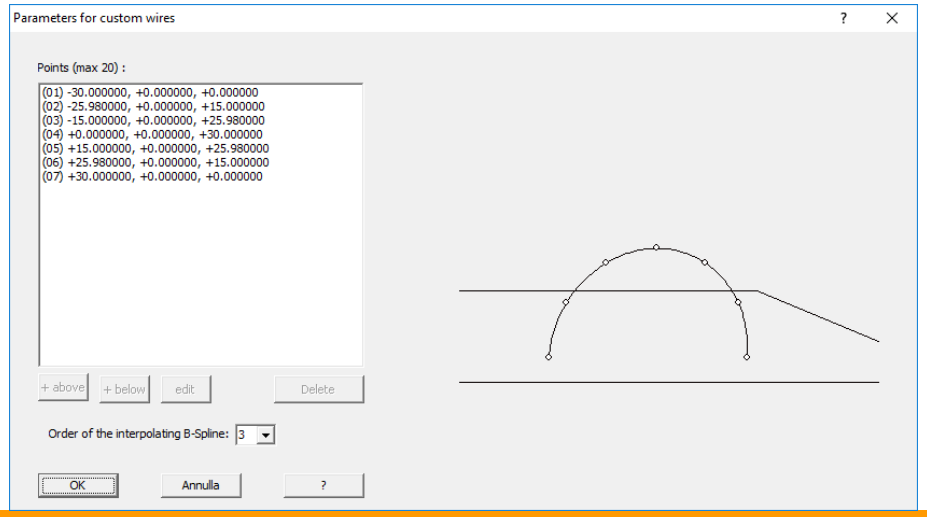
Parameters associated to each wire type:

- Linear wire
  - ✓ P1
  - ✓ P2

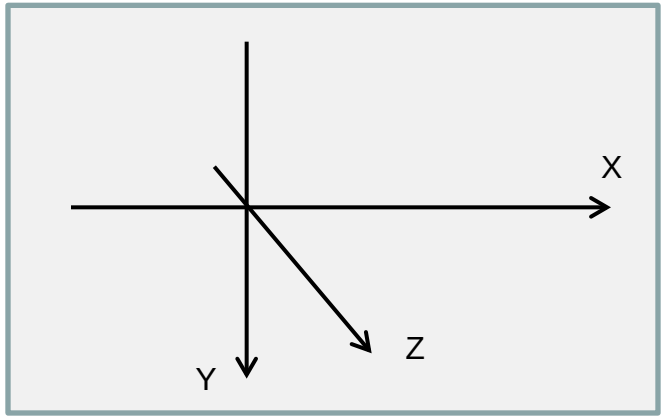


- Catenary
  - ✓ P1
  - ✓ P2
  - ✓ Sag s

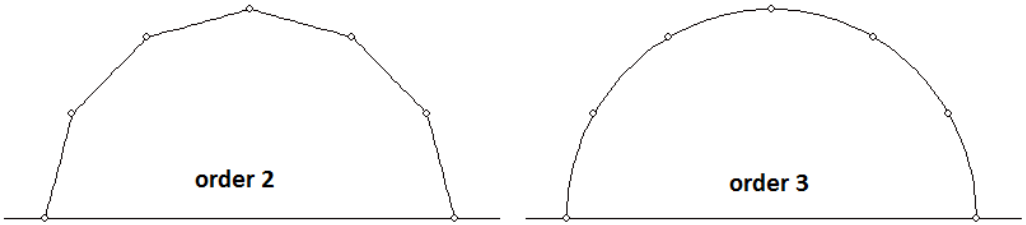
- Custom wire
  - ✓ P1
  - ✓ P2
  - ✓ Points (max. 20)
  - ✓ Spline order



Points coordinates are defined in a reference system (common to every section of the program) where **x** and **y** axes lay on the dial plane, x rightward and y downward, and the **z** axis is perpendicular and coming out of the dial plane. Origin position is arbitrary.

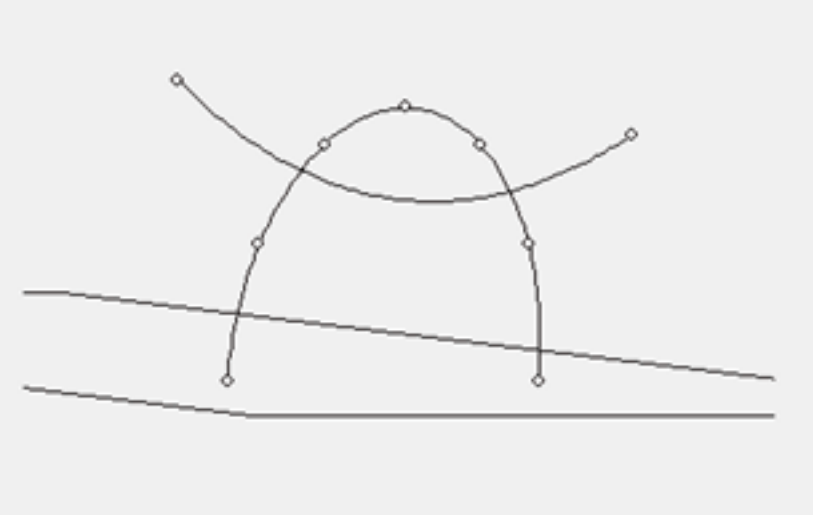


For custom wires the order of the Spline curve defines how points are connected together. As an example for a semicircle:



Number of points must be greater than or equal to the Spline order.

In order to permit the immediate verification of the inserted points, both the «Style» and the «Parameters for custom wires» windows show in their right side a perspective view of the wires:



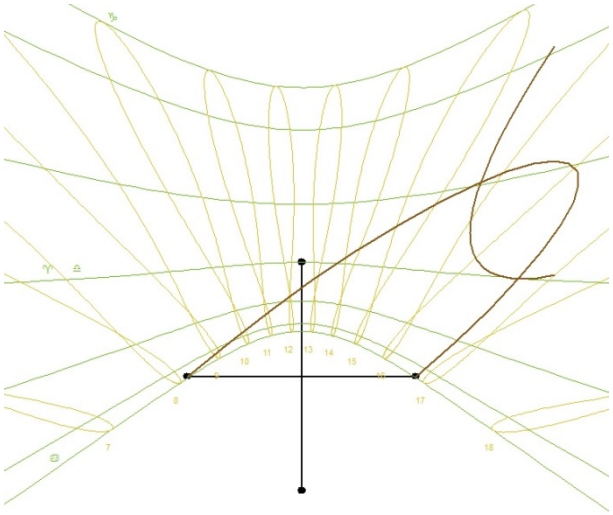
This view is updated after any data change.

It is possible to change zoom level and point of view of the drawing by means of the mouse:

- wheel: change the zoom level
- left button: drag the drawing
- right button: rotate the drawing

Warnings

It cannot be guaranteed that one only intersection exists between the two shadows: multiple crossings create ambiguity when reading the sundial.



Despite the existence of multiple intersections, the program could always converge to the same crossing, and the hour lines pattern would so look apparently correct.

It is therefore always convenient to use the simulation feature of the program to verify if the sundial behaves as desired at each date and time.

For custom wires there is no special restriction when defining points positions: it is so possible to define a wire that does not lay on a plane.

In this case program results are still correct however manufacturing drawings are not made available as they are 2D projections only and they would be misleading. When this is the case please use the DXF output file as manufacturing documentation.

Examples

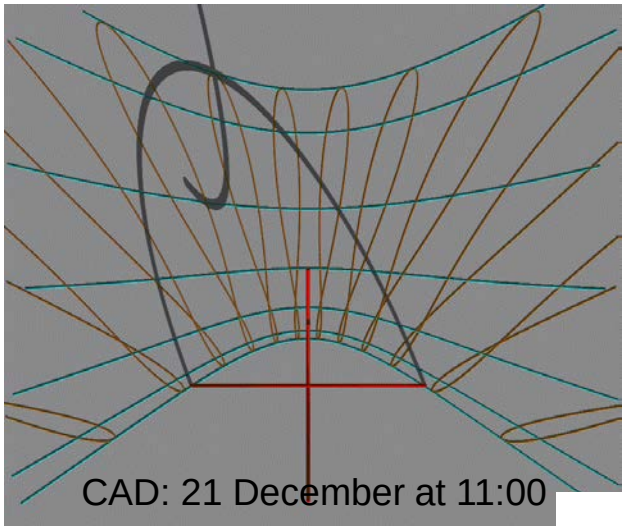
The following pictures show some examples of bifilar sundials designed by means of Orologi Solari.

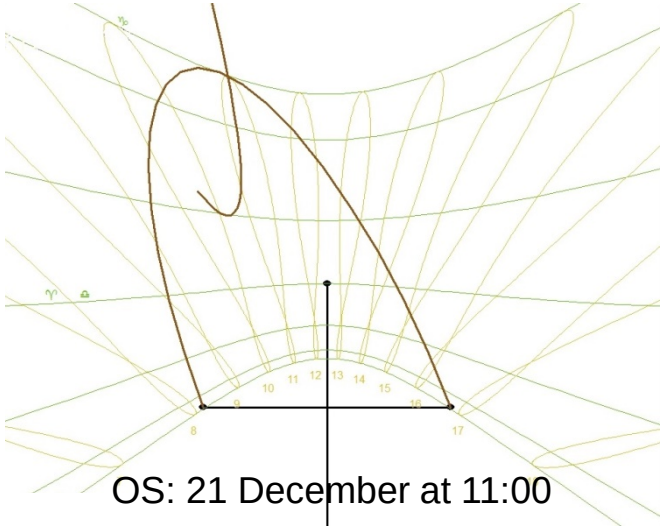
For each sundial the position of the wires on the dial plane is shown.

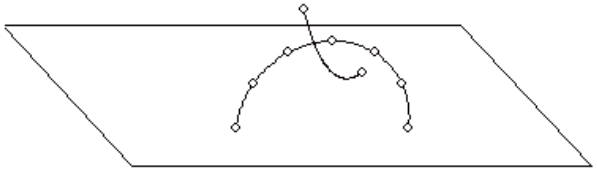
Some simulation results are then shown. They are obtained from Orologi Solari and from a CAD program (the project has been exported to a DXF file and then imported in the CAD program where every line has been given a proper width).

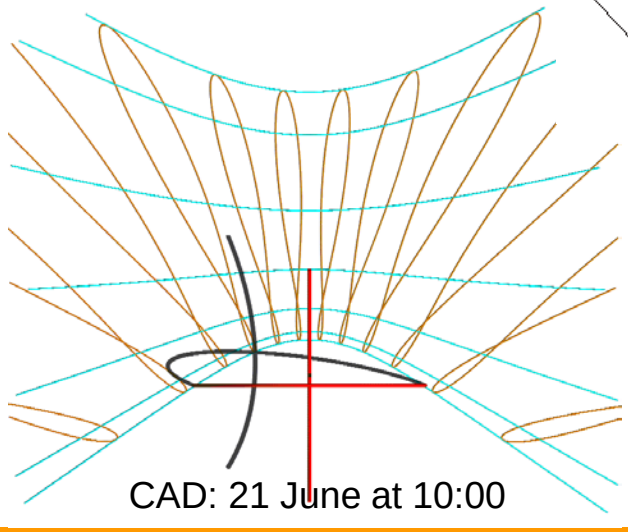
The last example (double helix on polar plane) demonstrates how Orologi Solari can correctly manage wires that are arbitrarily placed in space and that are not laying on a plane.

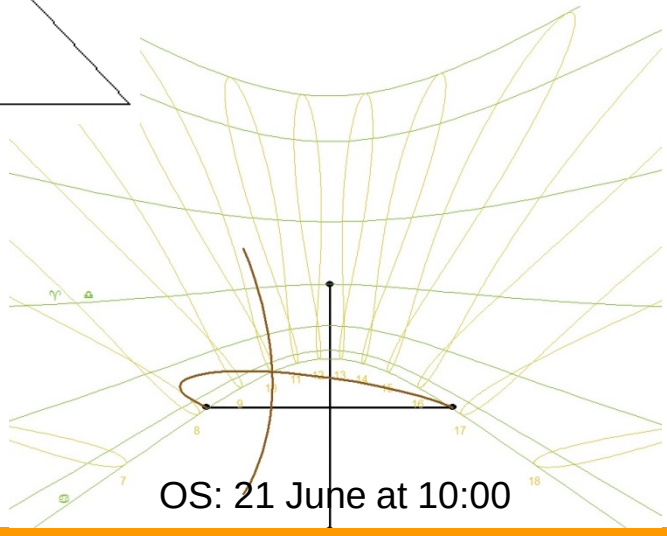
Horizontal bifilar sundial with catenary and semicircle


CAD: 21 December at 11:00

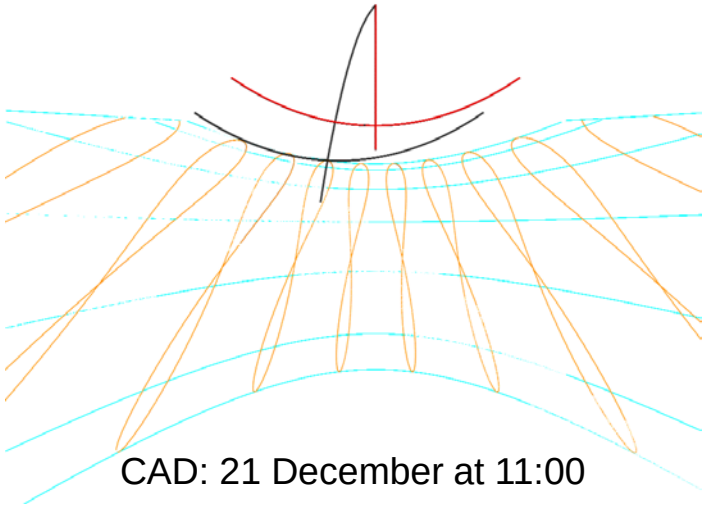

OS: 21 December at 11:00



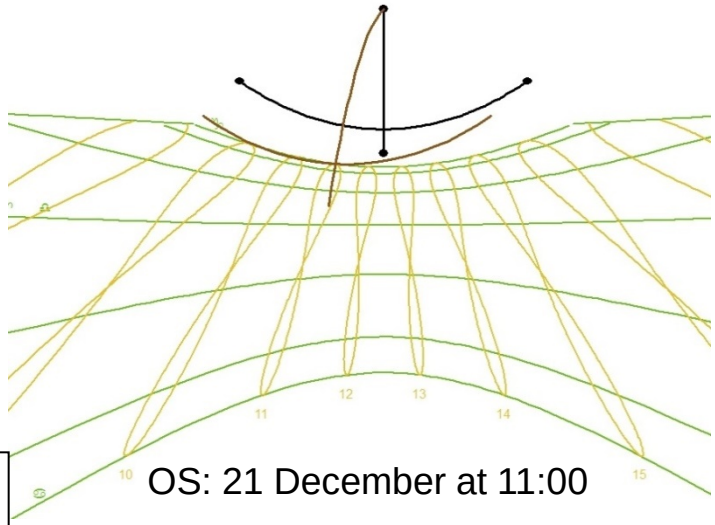

CAD: 21 June at 10:00


OS: 21 June at 10:00

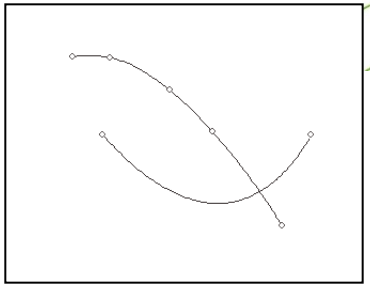
Vertical bifilar sundial with catenary and parabola

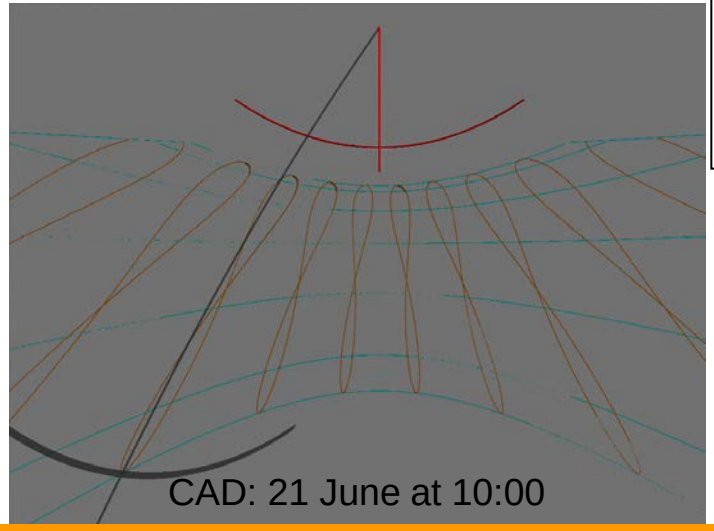


CAD: 21 December at 11:00

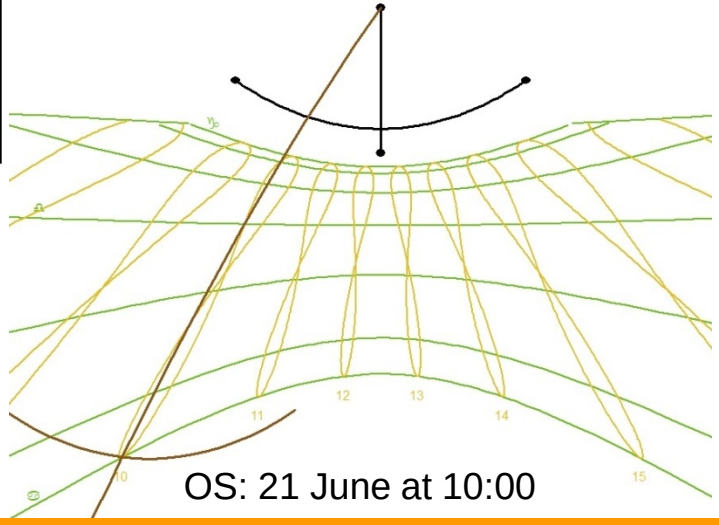


OS: 21 December at 11:00



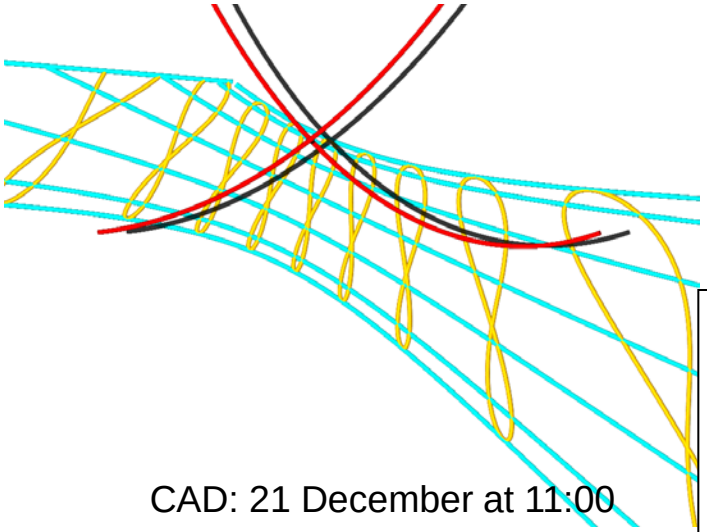


CAD: 21 June at 10:00

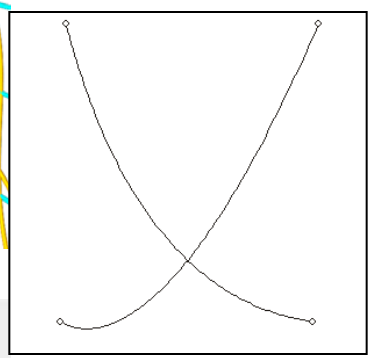


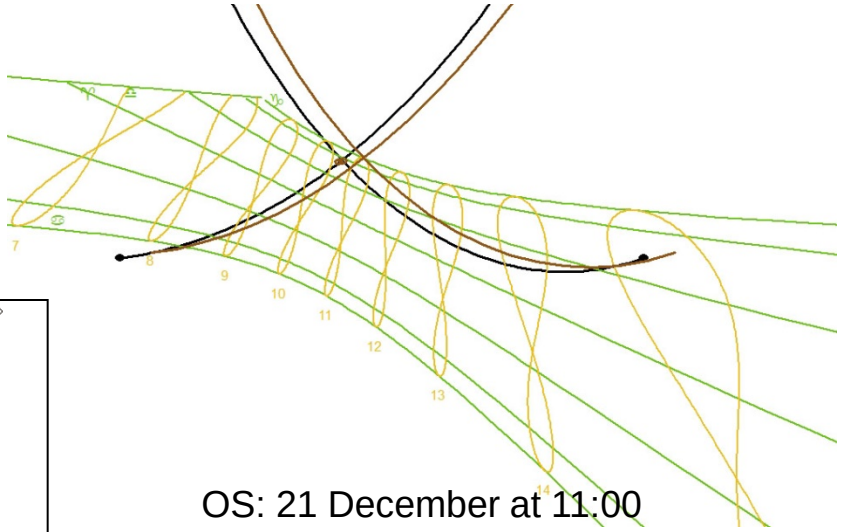
OS: 21 June at 10:00

Declining inclined bifilar sundial with double catenary



CAD: 21 December at 11:00





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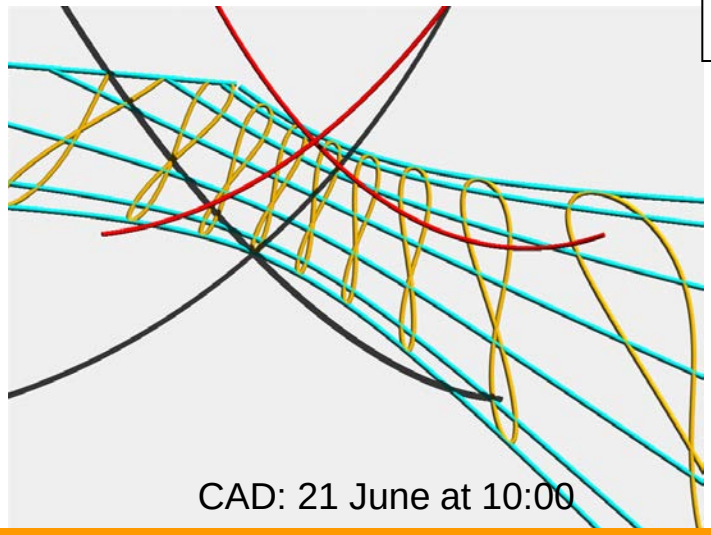

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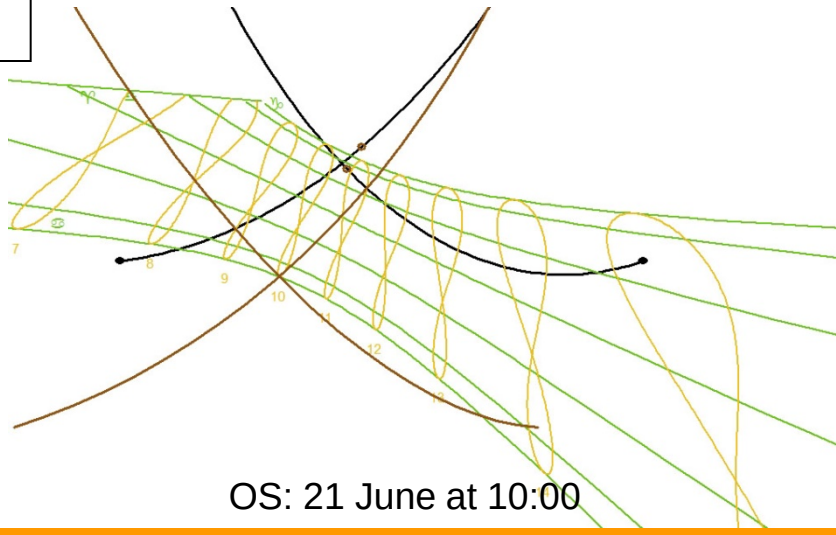
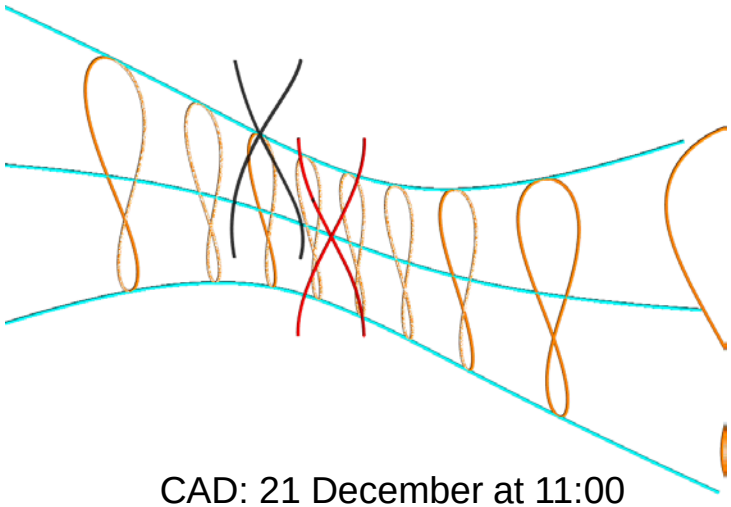
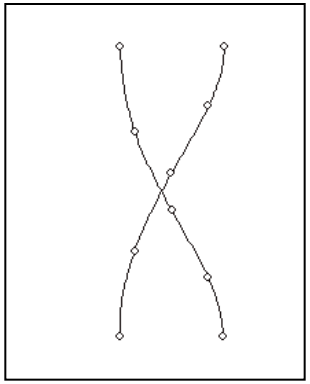


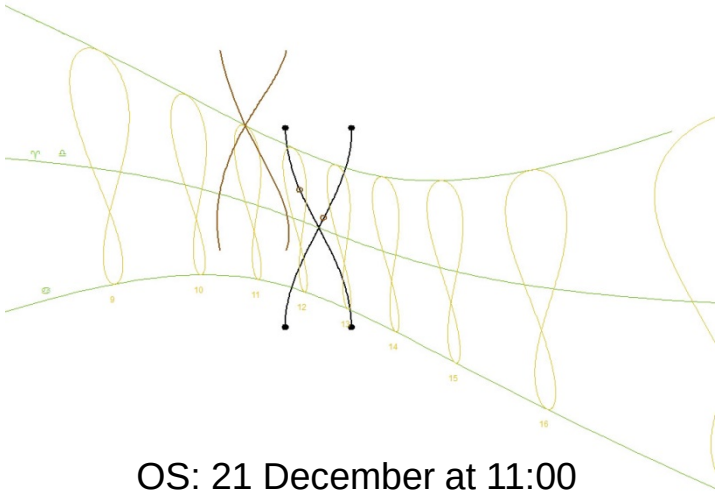
OS: 21 June at 10:00

Polar bifilar sundial with double helix



CAD: 21 December at 11:00





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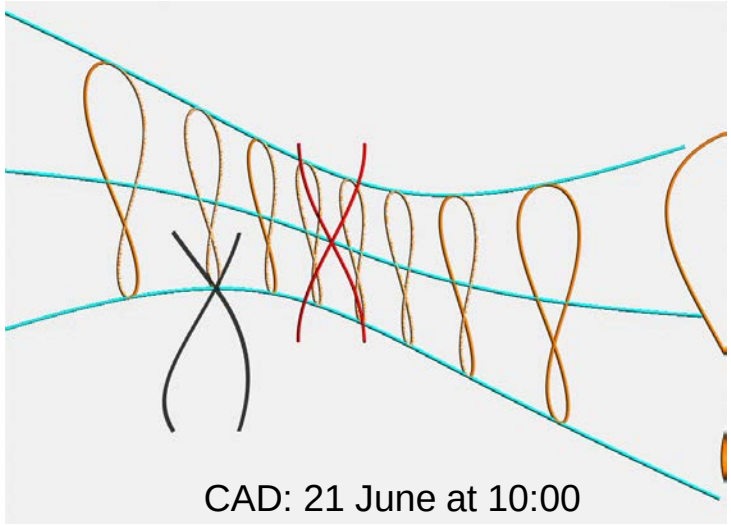

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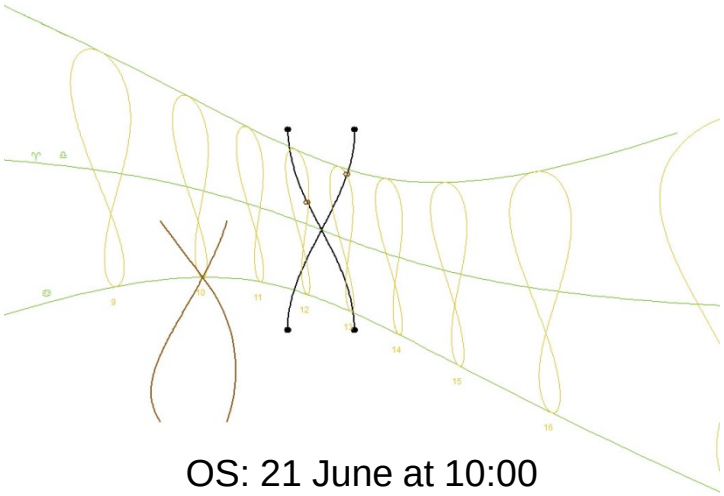

OS: 21 June at 10:00

Polar bifilar sundial with double helix

You can see a short movie showing the simulation of this sundial at:

https://youtu.be/tD22oba6RyQ