The Reconstruction of the Antikythera Mechanism

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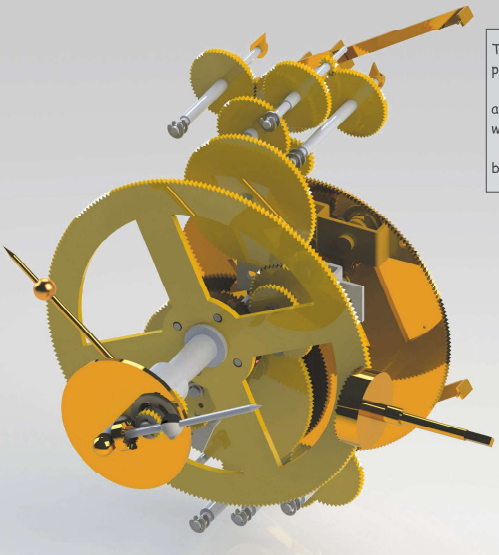
The idea for a functional reconstruction of the Antikythera Mechanism was born in 2008, after a well received lecture by John Seiradakis, when Kyriakos Efstathiou approached him and proposed that it would be possible to reconstruct the Mechanism, using the resources of the Aristotle University. The reconstruction wouldn't be possible if the attempt was not matched by the three sciences incorporated in the Mechanism: Astronomy, Engineering and Archaeology. Therefore, naturally, the team was joined by Stella Drougou, from the Department of History and Archaeology.

Continuous encouragement and support has been offered by the Aristotle University of Thessaloniki with the establishment of Magdalini Anastasiou's PhD grant and by financing the design and construction of the new functional model, which was undertaken by the Mechanical Engineering graduates, Alexander Basiakoulis and Marianna Efstathiou.



The originality of the idea is based on the fact that the dimensions of all parts of the Mechanism would be re-calculated under two considerations:

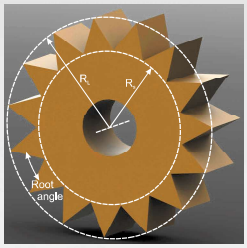
a) The dimensions of all parts and their mutual distance should comply with the measurements of the fragments published in the Nature articles.

b) All elements should be mechanically assembled in a functional model.

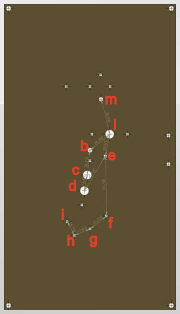
1. The Geometry of the Gears

Initially all geometrical parameters of the gears were calculated following the measurements on the X-ray data. A Fortran software application was written to calculate:

- the root angle of the gears
- the outer radius, RL, and the inner radius RS of the gears
- an index of proportionality between the outer radius, RL and the number of teeth, Z.

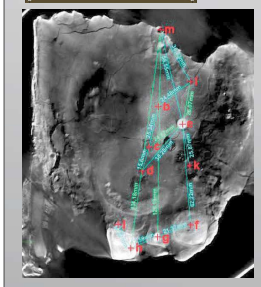


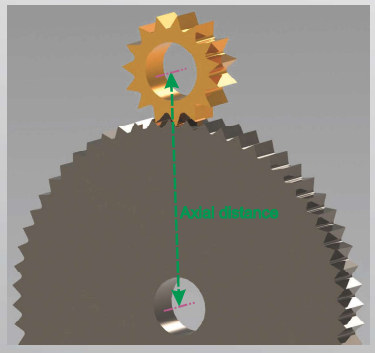
2. The axial distances



The axial distances between the gears were carefully measured on the X-ray data using the VG Studio Max application.

A Fortran application was written in order to calculate the tolerance of the axial distance so that the gears would rotate without blocking. Using the results of the geometrical analysis the calculated axial distances were compared to the measured distances.

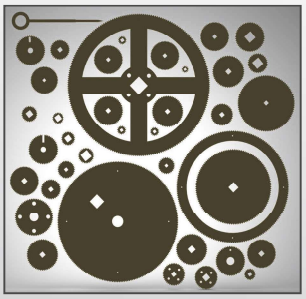


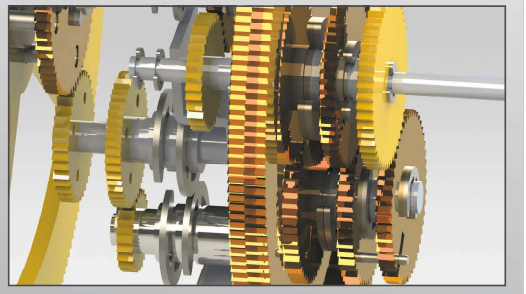


3. Design and Simulation

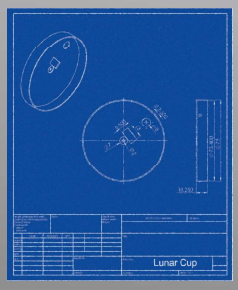
Having, thus obtained all necessary geometrical elements the 3 dimensional design was achieved using the SolidWorks software. This is the first time that a 3D reconstruction of all elements of the Antikythera Mechanism is undertaken aiming to the construction of a functional model.

At this stage the complexity of the axles and shafts of the Mechanism was revealed. During the design stage the axial distances of all pairs of gears was verified once again. This was followed by a 3D digital assemblage of the Mechanism.





4. Cutting the gears and fittings

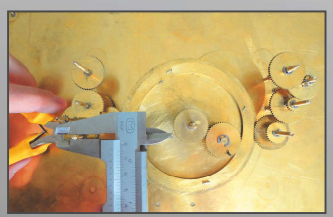


The tree dimensional design was converted to mechanical drawings, bearing all necessary information for mechanical processing of all parts of the Antikythera model.

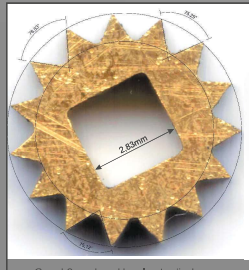
The gears were cut using an electro-discharge technique. The axles and shafts were shaped using a digital CNC lathe. The dials, divisions and all letters on the protecting plates were inscribed with an engraving laser. In order to obtain a literal copy of the ancient inscriptions a new true type font was constructed and used.

The gears, the axles and shafts, the pointers, the inscribed plates and all other components of the ancient Mechanism were converted from digital form to real functional parts.

5. Assemblage



Leaving the digital world, the Antikythera Mechanism was facing now the real mechanical world. The seemingly easy assemblage proved to be a delicate matter that needed special effort. The tiny parts and the small tolerances that were necessary for a functional model still revealed a few necessary corrections. After these corrections the Mechanism reached its final functional state.



Gear h2 produced by electro-discharge

Gear h2 designed by the SolidWorks software