PROCEEDINGS OF SCIENCE

THE RECONSTRUCTION OF THE ANTIKYTHERA MECHANISM

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From Antikythera to the Square Kilometre Array: Lessons from the Ancients,
Kerastari, Greece
12-15 June 2012

PoS(Antikythera & SKA)034

Summary

The construction of the original model of the Antikythera Mechanism is placed during the 2nd century B.C. The discovery of its remains, which took place in the year 1900 A.C., initiated an ongoing research so as to determine the facts that govern its operation along with the purpose that it served. It is the first device of the ancient world in which gears are used, with the form that are used in modern applications. In the present work, a new design study is attempted, following an engineering approach and incorporating the most recent findings that came to light. Final purpose is the construction of an operational replica in real dimensions and as close to the prototype as possible.

The new findings relate to the gears, redefining the dimensions of their basic geometry. For the construction of a working model of the Mechanism, the precise geometrical characteristics of all gears are needed. The roadmap followed three different paths in order to find a solution. (a) It used the measurements of all gears found in the fragments of the Mechanism. (b) It determined the root angle, the module and the chord length of all gears. (c) It calculated the axial distances of all cooperating gears that are necessary for the Mechanism to be functional. The design of the pointers of Meton and Saros, the two spiral scales of the back plate, was revised. In addition, the ability to distinguish new parts of the written text on the door and scale plates, revealed new information regarding the measuring values of the Mechanism /1,2,3,4/.

The model and its several parts were designed parametrically intending to a geometrically flexible final output. The related geometries among the parts are constrained to each other. This method conduced greatly the use of the tools provided by the modern 3D CAD systems.

Having reached a final form for the proposed model follows the simulation of the movement of the different parts in the assembly and the operational check prior to the construction.

Finally, the manufacturing designs are generated so as for the last part of the design study to take place, which is the manufacture of the model. With the approach that was followed in every step of the study, the derived model is one of the most consistent constructed models yet, by means of form, dimensioning, material, assembling and inscriptions that brings on its plates.
The most recent findings that accrue from the study of the fragments were considered as the base for the definition of the geometry of its parts. While selecting the material, form and dimensions of the different components particular attention was paid so as to preserve the basic working principles of the prototype, with the purpose to achieve the highest possible fidelity of the copy.

The design of the various elements followed. Because the research regarding the Mechanism is ongoing, it was considered best to create a model that is adaptive to various combinations of dimensions and forms minimizing the time required for redesign. The principles of parametric design were applied for the creation of the models. Initially, for each set of similar functioning items, the basic elements that describe their geometry were defined. The relationships that connect these elements were given, as they are dictated from their operating requirements. Next, the values of the dimensions were given as parameters capable of changing. Last, the common elements of geometry among the items were linked so that a change to the geometry of one item leads to direct readjustment of the dependent items.

Following this, the various models that derived from the different combinations of geometric values was simulated to identify possible problems. The results of the simulation led every time

to re-evaluation and re-adjustment of the dimensions causing failure. Finally, the ideal form of the model emerged, at least from a functional standpoint.

The final result of the study was the creation of the manufacturing designs for the final stage which is the model's construction. In addition, designs were created to lead the assembly of the Mechanism through the necessary exploded 3D model views. The use of several manufacturing methods resulted to the final operational model, dimensionally consistent to the prototype and using the same material.

Details of the Reconstruction with extensive illustrations are shown in the accompanying poster file.

References

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