A STUDY OF POSSIBLE GEOMETRIES OF MODULES FOR SHAPE CHANGING AND SELF RECONFIGURABLE ROBOTS WITH THE USE OF INTERACTIVE WOLFRAM MATHEMATICA DEMONSTRATIONS.

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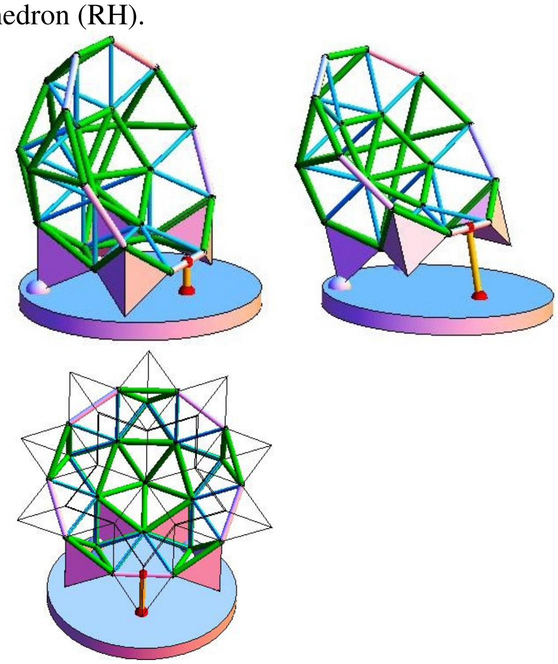
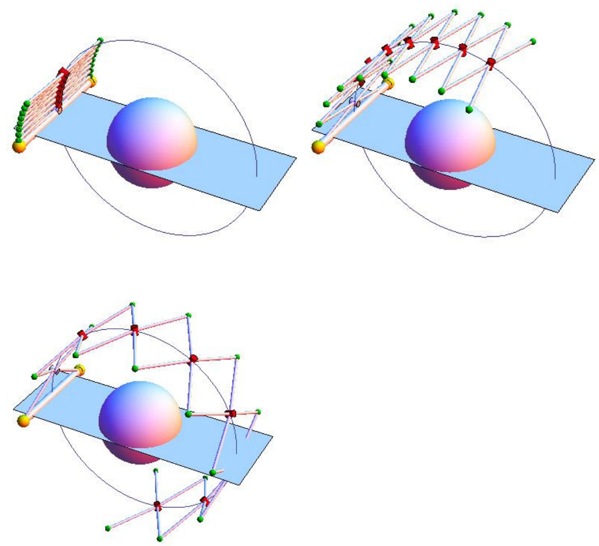
Introduction: Robotics plays fundamental role in space probe construction. Subsystems with suitable shapes also have basic importance in structural construction of the space objects. These two aspects are superimposed in this abstract [1]. In the design of possible robots to be used in space exploration the geometry of modules is essentially determine the ways of changing the shape and reconfiguration of mechanisms. Folding and expanding mechanisms are needed basically to save packaging room during transportation. The self reconfiguration of modules in robots could be used to change the overal functionality of the robots serving specific purposes. This abstract shows a few examples from the many different solution mentioned in a study study of possible geometries to be used for the modules that can be potentially used in shape changing and self reconfiguring robots.

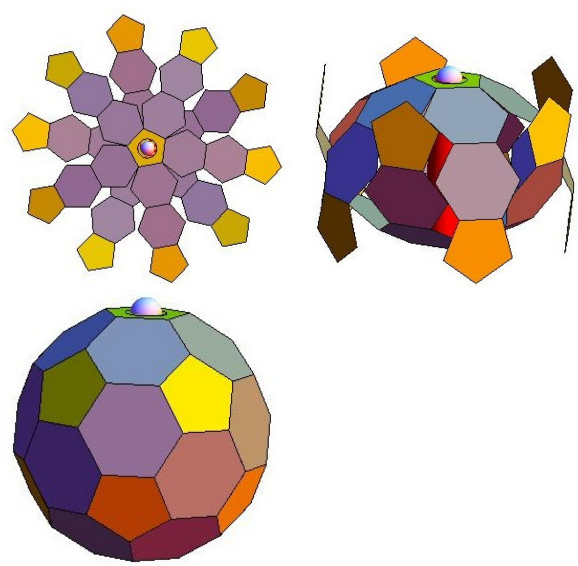
Lattice Parabola: A lattice structure placed on a rotating platform. The axis of the structure can be adjusted. This arrangement could be used for supporting parabolic antenna. The geometry of the lattice structure is derived from rhombohedron (RH).



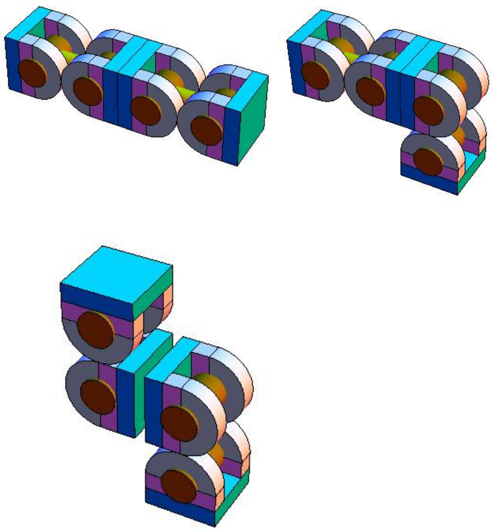
Shelter. Each member of Nuremberg scissors is bent at the fulcrum so that the end points are on a cylinder. For deployment it is enough to control the distance of two ends of a scissors.



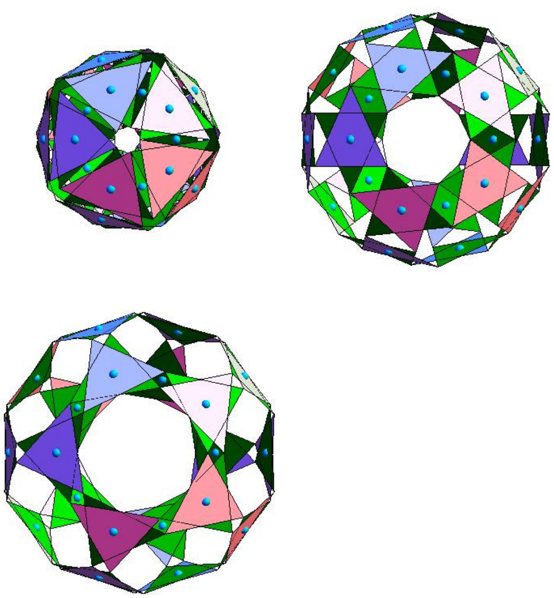
TICO fold. A **T**runcated **ICO**sahedron structure is assembled from two identical parts placed on each other by folding. Folding takes place while elavating one part with a central lifting device.



Two robot units having an **overall shape of a cube** each, are joined together with hinges to form a pair of units for constructing self reconfiguring robot.



Expanding Icosahedron Double. Each face of an icosahedron is doubled, then moved in radial direction, while turning triangular faces of each pair around the axis in opposite direction. The vertices of the triangles remain in contanct during the movement. At a certain distance the triangles cover each other again at the position of an icosidodecahedron. Thus a self supporting expanding framework is produced.



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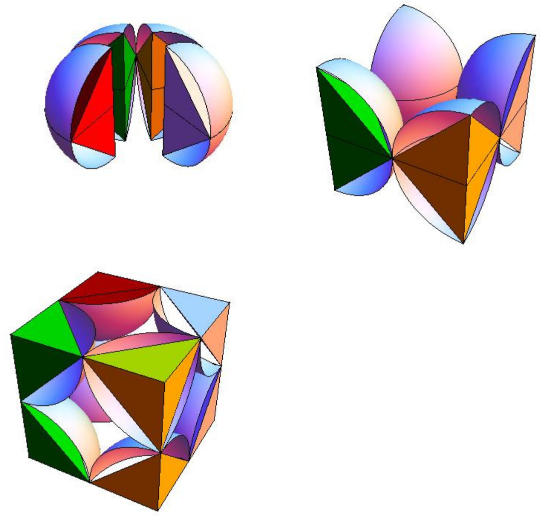
Sphere-Cube. A sphere is cut into eight congruent segments, then the segments are turned to form a cube.



Summary: Shape and robotic planning are connected in the Wolfram Mathematica Demonstrations shown in this paper. The visualized movements serve the space view of students. The elements can be used as virtual constructing blocks when a new complex space form should be planned. We used these demonstrations in planning the truss, the arrangement of instruments and new experiments on Hunveyor-Husar models, too.

References:

[1] http://demonstrations.wolfram.com/

[2] Kabai S. (2002): *Mathematical Graphics I. Lessons in Computer Graphics Using Mathematica*. Pp. 279. Uniconstant, Püspökladány; [3] Kabai S. (2006): *Mathematical Graphics. The Number Seven*. Pp. 48. Uniconstant, Püspökladány; [4] Kabai, S., Miyazaki, K., Bérczi Sz. (2002): Space Science Education with Mathematica: Interactive Design Modular Space Station Structures with Computer Algebra: Principles, Functional Units, Motions, Examples. *LPSC XXXIII* #1041, LPI, Houston, CD-ROM. [5] Kabai, S.; Bérczi, Sz. (2006): Space Stations Construction by Mathematica: Interactive Programs to Use the Double Role of the Golden Rhombohedra Modules (The Crystallography of a Space Station). 37th LPSC, #1121, LPI, Houston; [7] Szilassi, L.; Karsai, J.; Pataki, T.; Kabai, S.; Bérczi, Sz. (2001): How Interactive Graphical Modeling Helps Space Science and Geometry Education in Hungary. 32nd LPSC, #1184, LPI, Houston; [8] Kabai S., Bérczi Sz. (2009): Rhombic Structures. Geometry and Modeling from Crystals to Space Stations / Rombikus Szerkezetek. Geometria és modellezés a kristályoktól az űrállomásig. Uniconstant, Püspökladány (ISBN 978-963-87767-3-0).