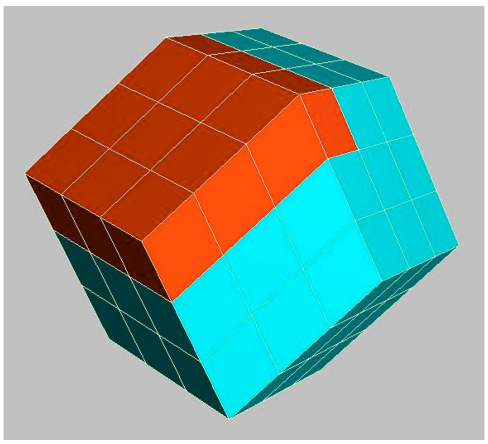
Virtual True Rubik Rhombododecahedron

by Eduard Baumann

Rotational puzzles can be played virtually in a computer programm. If real versions of such a rotational puzzle are available on the marketplace then there is no doubt that they are superior to any virtual version.

It is possible that very obvious generalisations of real rotational puzzles are very hard to realize. The necessary mechanics can be very difficult or impossible.

In such cases a virtual programm may be more convincing. Lets look at the Rhombododecahedron which still has a small number of faces (12). Here is an illustration which shows the rotated part (slice) in another color:



Only 180° turns are allowed. One element of this slice forms a hook so a mechanical realisation is certainly difficult.

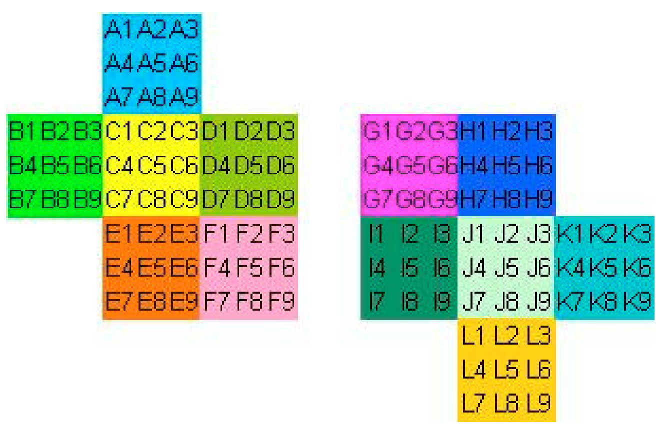
A programmed rotational puzzle can have the very big advantage of easy undo's and the automatic execution of compactly written sequences. It is also possible to retain the whole history of all movements done on the puzzle.

I recommend do this programming in a simple Excel worksheet. Use the following guidelines in doing so.

Principles

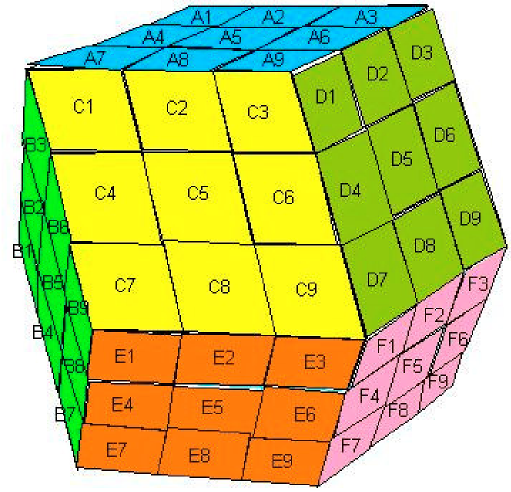
(a) record simple cell circulations
(b) give such recordings one letter names
(c) have one macro which calls all such recordings following a sequence given in form of a letter string in the selected cell
(d) the saving of positions are simple copy/pastes and ‘undo’ can also be prepared by copy/paste.

The forced cartesian arrangement of the cells in the Excelsheet shows as follows (shown are at left the front part and at right the back part seen from inside). A better view is offered by a “showing” macro which transfers color and value of cells to the associated drawing elements. In order to not loose interesting aspects it is clear that all parts must be distinguishable. This can be obtained giving a individual letter for each label.



Here the front sight is shown with drawing elements.

In the following the letters C,D,E, … mean the turning of the corresponding slice by 180°.



Only the turning of slice C and two turnings of the whole rhombododecahedron (front 90° V and right above 90° R) are predefined. With this all other turns can be constructed. For example D=<u>V</u>CV.

Notation:

<u>V</u> is the inverse of V. The elements in round brackets change place in a cycle. [<u>R</u>F] is the commutator of <u>R</u> and F and means <u>R</u>FR<u>F</u>.

The near neighbourhood commutator NNC [CD] gives an edge cycle (C4 C6 D6), a 4-Vertex cycle (C9 D3 C1) and a 3-vertex cyle (C7 C3 D9). The elements are quoted with only one representative label.

The far neighbourhood commutator FNC [CF] yields a pure 4-vertex cycle (C1 C9 F9).

The edges are organized in 4 separated orbits. They correspond to the “zones” of our polyhedron which is a zonohedron. You can observe that all edge elements return to their home place without any twist. This is also true for the 3-vertices (corner with 3 edges) but NOT for the 4-vertices.

A 3-vertex cycle without disturbing edges can be built as follows. Turn the operator [CD] by 120° around C7 to get [CD]*= V<u>R</u>VV [CD] (V<u>R</u>VV)^(-1). The two operators have only C7 in common so that their commutator [[CD] [CD]*] gives (C3 C7 E9).

You also need an operation which reorients 4-vertices. Lets work around C9 to build this operator. The sequence DAC brings C9 back but turned. The following 4-vertex cycle for C9 doesn’t use the the operations D,A and C : [EI]. Hence the commutator [DAC [EI]] yields two 90° turns C9+ and J1- without disturbing anything else.

With all this sequences you can apply the following strategy

(a) place all edge elements with NNC's
(b) place all 3-vertices with [[CD] [CD]*]
(c) place all 4-vertices with [CF]
(d) orient the 4-vertices with [DAC [EI]]

An Excelsheet with the True Rubik Rhombododecahedron is available at baumann@mcnet.ch.