Jaap's Puzzle Page

Dogic

This beautiful puzzle has the shape if a regular icosahedron. Its 20 triangular faces are divided into 4 regular triangles. There are two types of moves: Twisting the 5 complete faces meeting to a vertex (face twist), or the 5 small triangles at a vertex (tip twist).

When the puzzle is solved, each vertex has 5 triangles of the same colour. The central triangles of each face have three colours, and these should match the adjacent triangles.

I have taken mine apart to see how it worked, and found that it is made of an amazing number of parts. There are 60 vertex triangles, 20 central triangles each with 3 inlaid coloured parts, 60 internal pieces to keep the vertex triangles together, 30 internal pieces to keep the central triangles together, a central piece with twelve axes each with two rotating parts and a screw. This gives an incredible 267 pieces (or 194 moving parts).

This puzzle was patented by Zoltan and Robert Vecsei in Hungary on 20 October 1993 (HU 214,709), and the patent was granted nearly 5 years later on 28 July 1998.

The number of positions:

There are 60 tip pieces and 20 centres with 3 orientations, giving a maximum of $60!\cdot20!\cdot3^{20}$ positions. This limit is not reached because:

- only even permutations of centres are possible (2)
- the total twist of the centres is fixed (3)
- some tip pieces are indistinguishable ($5!^{12}$)
- the orientation of the puzzle does not matter (60)

This leaves $59!\cdot20!\cdot3^{19}/2/5!^{12}$ =
21,991,107,793,244,335,592,538,616,581,443,187,569,604,232,889,165,919,156,829,382,848,981,603,083,878,400,000
= $2.1\cdot10^{82}$ positions.

Despite its apparent complexity, the solution is not very difficult.

Solution:

Phase 1: Match tip pieces to the face centres.

a. Choose any tip triangle that is not adjacent to a correctly coloured centre piece. Say the tip has colour A, and it's centre has colour B. Use any face twists necessary to place a face next to it at the same vertex which has tip colour B, and centre colour C. Similarly put faces next to that with colours C and D, D and E, and finally if

possible E and A.
If there is no incorrect tip with the colours E and A, the final tip at the vertex may have only one of the colours, or even none but then it should be a tip that is not already matched correctly.

b. Now twist the tip, so they match the colours of the centres.
c. Repeat the above as often as necessary, until there are no incorrect tips left.

A few hints:
1. Use faces which have 2 or 3 unmatched tips before using those with only 1.
2. The colours A-E above need not be all different. For example, if you end up with only two unmatched tips, places them at a tip with 3 matched pieces of one of the colours.

Phase 2: Solve faces.
This phase is exactly equivalent to the solving of the Impossiball. See there for the details.

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