Amazing Labyrinths, Further Developments

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Abstract

This short paper elaborates on findings presented at the 2007 Donostia Bridges Conference [1], first bringing some classifying logic in the family of labyrinths of which the 'Classic' and 'Chartres' are the best known examples, with the interesting inclusion of spirals. Second, another 3-dimensional morphing is offered on the surface of a sphere, which underscores the inherent antisymmetric nature of the 'Classic' and Chartres' designs. Third, appealing 3-D forms can result from projections onto polyhedra, here the octahedron/cube duals. Fourth, a recent arrangement of the 'Classic' into a rose-shape is proposed for possible mathematical analysis. The figures of this paper, including an important erratum correcting a wrong figure that didn't make it in the printed Donostia Proceedings, are provided as an appendix in the CD-Rom of the Proceedings of the Conference, but not on the printed Proceedings. They are further expanded by entries at the accompanying Bridges 2009 Mathematical Art Exhibit [2].

Introduction

The title "**Amazing Labyrinths**" [1] goes beyond a mere easy play of words. In the class of *unicursal* '**labyrinths**', we consider from a geometrical viewpoint the subclass 'centered' around the characteristics (see [1]) of the 'Chartres' design amplifying the old 'Classical/Cretan/Knossos' design. Its members share the interesting property that their 'walls', i.e. the space delimiting the 'Ariadne' journey that meanders to the center, actually constitute 'walkable' *multicursal* '**mazes**', complete with 'choices' and 'dead-ends' (refer to those mystifying paths enjoyed by children and adults alike in labyrinthine theme parks and which in fact are mazes). The essential point that makes so special those mazes stemming from this subclass of labyrinths is that their 'dead-ends' are opposite pairs that can be joined by tunnels, bridges or Japanese steps for these mazes to be turned into '**closed circuits**', when in addition the 'transversal choices' are denied access! This was fully expressed in several 'trompe-l'oeil' works and in the sculpture project presented at Bridges Donostia [1] and at the accompanying Mathematical Art Exhibition [3].

1. From Spirals to the 'Classic', 'Chartres' and Beyond

As suggested by Raket [4] the meandering plowed track packing the agriculture field might prefigure the labyrinth, and Kern [5] as well as Raket again see in the spiral a precursor of the 'Classical' labyrinth. So, spirals and 'Chartres'-like labyrinth layouts can be brought in a comprehensive system based (a) on their 'seeds' as in earlier remarks by Tony Phillips found on-line in [6], where some necessary corrections have been introduced, and (b) on further developments of the typical Chartres' 'opposite returns' mentioned in the Introduction. This has led to combining 'seeds' and 'opposite returns' in large complex labyrinths that, with a leap into still further developments as hinted to in the next section, could go 3-D! In the same vein of strange/magic labyrinth generation, we need referring to another spiral-to-'Classic' transform by Slavik Jablan as cited and shown in [7], and, in a ludical context, placing half as many children as there are 'perimetric dots' around a given labyrinth 'seed', seashore or chalk labyrinths can readily be generated in choregraphic pleasing dynamics as displayed in the Math Art Exhibition [2].

2. From Disk to Cylinder to Sphere and Beyond

The Donostia paper [1] illustrated a disk-cylinder morphing transform. Here, pushing this 3-dimensional interpretation to the end, by swelling the mid-part of the cylinder, brings about the spherical labyrinth (see [8,9]) that magnificently stresses the inherent antisymmetric nature of the 'Classic' and 'Chartres' designs related themselves, as described in previous paper and elsewhere, to a Greek freeze meander. 'Chartres' typical turnabouts and trough passages giving rise to the 'pilgrim steps' [1] remain as apparent as on the cylinder and on the rectangle (that by could be curled into a cylinder in the other direction as well, I found out) and suggested the idea this class of labyrinths can be generated from infinite lattices of such steps [10]. No doubt Dick Termes could develop this brilliantly further in his trademarked craft [11]!

3. Projection of Labyrinths onto Polyhedra

This alternate kind of 3-dimensional interpretation to the above-mentioned stems here from the square and hexagon as projections of the octahedron (and of the pyramids it's composed of) and the cube, where the *squared* and *hexagonized* micro-Chartres labyrinths have been used. Such exercises could be further tempted with other polyhedra, which recalls some maze work by Xu and Kaplan [12].

4. A Labyrinth/Knot Rose Submitted to Mathematical Scrutiny

'Roses' are this year's theme of the 'Jardins d'Aywiers' garden fair, so my eighth ephemeral veggie labyrinth there had to feature some rose-like shape, beyond what could have been more simply suggested by the central rose of the Chartres design reflecting the huge stained glass rose above the front porch of the famous cathedral. Pairs of 'walls' of the classic labyrinth have been twisted, which reminds architectural work by Glaeser and Gruber [13].

Acknowledgments, Copyrights and References

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[1] Samuel Verbiese, *Amazing Labyrinths*, Proceedings of the Bridges Conference in Sonostia, 2007.
[2] Samuel Verbiese, http://www.bridgesmathart.org/art-exhibits/bridges2009/verbiese.html.
[3] Samuel Verbiese, http://www.bridgesmathart.org/art-exhibits/bridges2007/verbiese.html.
[4] Jacques Raket, *Dernières nouvelles du labyrinthe*, Editions la mesure du possible, 2006.
[5] Hermann Kern, *Through the Labyrinth : Design and Meanings over 5,000 years,* English Edition by editors Robert Ferré & Jeff Saward, Prestel, 2000.
[6] Tony Phillips, http://www.math.sunysb.edu/~tony/mazes/classify.html, many links, a.o. /index.html.
[7] Reza Sarhangi, *Making Patterns on the Surfaces of Swing-Hinged Dissections,* Proceedings of the Bridges Conference in Leeuwarden 2008, p.252.
[8] Jim Buchanan, *Labyrinths for the spirit – how to create your own labyrinths for meditation and enlightenment*, Octopus Publishing Group Ltd, 2007, pp.36-37.
[9] Marianne Ewalt, http://www.marianne-ewaldt.at/kugeln99.htm.
[10] Interesting 'last-minute' discussions with John Sharp and Martin Demaine are here acknowledged.
[11] Dick A. Termes, http://www.bridgesmathart.org/art-exhibits/bridges2008/termes.html.
[12] Jie Xu and Craig S. Kaplan, *Vortex maze construction,* Journal of Mathematics and the Arts, Vol. 1, No. 1, March 2007, p. 18.
[13] Georg Glaeser and Franz Gruber, *Developable surfaces in contemporary architecture,* Journal of Mathematics and the Arts, Vol. 1, No. 1, March 2007, pp.59-71.