Papel, Dobragens e ... Matemática

Exhibition at the Faculty of Sciences of the University of Lisbon (ULisboa), 2018

Krystyna Burczyk (b. 1959)

Mathematician, teacher, artist

I graduated from Jagiellonian University in Krakow, Poland in 1983 in pure mathematics. I have has more than 20 years of experience as a math teacher. Started interest in origami in 1995.

My mathematical background pushed me towards geometric art. Mathematical structure of origami models and folding process as well as relation of origami to mathematics has been in the center of my interest from that time. I am also interested in educational applications of origami.

I am an author of six origami books and several booklets.

I was invited to participate in large international origami exhibition Masters of Origami exhibited in Salzburg 2005 and Hamburg 2007. I have also participated in the exhibition Folding Paper: The Infinite Possibilities of Origami which started in Japanese American National Museum, Los Angeles, USA in 2012 and later travelled until 2016 around various art galleries around USA. I had three exhibition in Hungary: Origami Geometry with Endre Somos in Pécs (2010), Poskładane myśli (Folded Thoughts) in the Polish Institute in Budapest (2015) and at the Symmetry Festival in Budapest (2009). In 2016 I participated in the exhibition Mujeres de Papel in Zaragoza, Spain.

My artworks were exhibited several times at the art exhibitions of Bridges, Mathematical Connections in Art, Music, and Science – in Pecs, Hungary (2010), Coimbra, Portugal (2011), Enschede, The Netherlands (2013), Seul, Korea (2014), Jyväskylä, Finland (2016) and Stockholm, Sweden (2018). In 2018 my two artworks were presented in the nominee gallery.

My works were exhibited at numerous origami conventions over the world in Czech Republic, France, Germany, Hungary, Italy, Japan, The Netherlands, Poland, Singapore, Spain, Sweden, Switzerland, UK, USA.

I gave lectures on theoretical and educational aspects of origami at Origami Science Math and Education conferences in Asilomar, USA (2001), Pasadena, USA (2006), Singapore (2010), Tokyo, Japan (2014) as well as Didaktik des Papierfaten conferences. In 2014 I participated in the international educational project Visual Math and contributed a chapter to the book Visual Math, Adventures on Paper. Math Based Activities for Experience-Centered Education of Mathematics. The book was printed in English, Hungarian and Serbian

My artworks were placed at the covers of books and journals: Bridges Pécs Mathematics, Music, Art, Architecture, Culture. Proceedings 2010; Bridges Pécs Mathematics, Music, Art, Architecture, Culture. Exhibition 2010; Bridges Stockholm 2018 Mathematics, Art, Music, Architecture, Culture. Proceedings; Origami 5: Fifth International Meeting of Origami Science, Mathematics, and Education; 5 OSME abstracts;

Revista de Ciência Elementar vol 6-2 as well as published in Origami USA calendar.

Nick Robinson in The Encyclopedia of Origami (Running Press, 2004) and by Lynn Gamwell in Mathematics and Art: A Cultural History (Princeton University Press, 2015) covered my art.

I have started and run for ten years the working group Origami and Mathematics in the Association of Teachers of Mathematics in Poland.

Twirls

It was 20 years ago when Herman van Goubergen from Belgium invented and used spirals for the first time to join paper modules. Nobody expected that this idea may be useful for modular origami but I, a Polish artist, decided to use this technique in my works. And Twirls have been born.

There are many types of Twirls, twirls that love symmetry, twirls that break symmetry, that show their structure, that hide their structure and such that are not able to decide. But there is always mathematics behind all of them with polyhedral structures, symmetry, parametrization, limits and equivalence classes. Spirals do not only join the structure, they also make it live. Twirls acts as organic forms, live themselves and use tension and friction of paper to fight against external forces.

'From Octahedron to Cube' is a way that starts from the octahedron with 6 vertices. Each vertex transforms into a square enlarging gradually, finally there are 6 squares at the surface and the object became a cube. The artwork consists of several steps on this way.

Such idea of a process with infinite number of intermediary steps is also visible in 'Accordion folds'.

In case of artworks of series 'Pencil Shavings', black lines focus our attention at spirals of the edges of twisted paper and show how straight lines transform into curves.

'Functions' use part of graph of a continuous function to twist curves on a plane into a spatial curve.

Geometric structures form a base for most of my artworks.

Sometimes the structure is easily visible as in case of 'Rose Petals Ball', 'Duo-Flaps', or 'Water Park'.

Sometimes the structure is not obvious from outside, but definitely it sits inside as in case of 'Surveillance', 'Eternity', 'People', and 'Together'.

Sometimes the structure before and after construction differs as spirals create additional polygons and make the structure more complex as in case of 'Winter in the park in Lisbon', 'Puff Star', 'The Rhombic Triacontahedron', and 'Hidden Treasure'.

When modules used for an artwork are not symmetric, change in their orientation results in the structure of the dual polyhedron as in case of 'Balls of Flowers' or 'Uplower'.

I know, I feel, I am sure that without mathematics there would be none of my artworks.

Artworks

Entre o Octaedro e o Cubo

From Octahedron to Cube

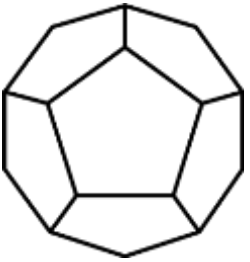
Created by Herman van Goubergen, Krystyna Burczyk
Folded by Krystyna Burczyk, 2008

All artworks of this series starts from the same size of square sheet of paper. Gradual increase of the central part shows in few steps how close are structures of cube and octahedron and duality of these solids. The elements are joined by spirals. Such technique resulted in broken symmetry, all orientation-reversing symmetries are eliminated (mirror and central symmetry) and only rotation symmetry is left in the symmetry group of the objects.

Duplinhos: Icosaedro truncado (Bucky-bola), Dodecaedro

Duo-Flaps: Truncated Icosahedron (Buckyball), Dodecahedron

Created & folded by Krystyna Burczyk, 2011

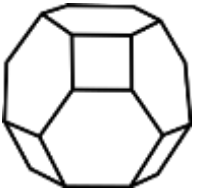


Estrela soprada

Puff Star

Created & folded by Krystyna Burczyk, 2009

Kusudama of 48 triangular modules, which form 8 hexagons, and 6 square modules.

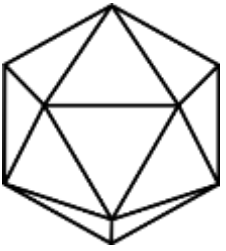


Triacontaedro rômbico

The Rhombic Triacontahedron

Created & folded by Krystyna Burczyk, 2010

The artwork made of 30 edge modules from rectangles based on the icosahedron structure. See connections between these two polyhedra.



Senhora Professora

Madam Professor

Created & folded by Krystyna Burczyk, 2016-17

Can you believe that copper parts are only decoration? The structure of the polyhedron is made by 120 black modules with 4 spirals each, but there are used only decagons.

You can compare with Duo-flaps which is similar but has a different structure.

Aranhas

Spiders

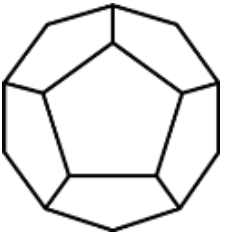
Created & folded by Krystyna Burczyk, 2009-2011

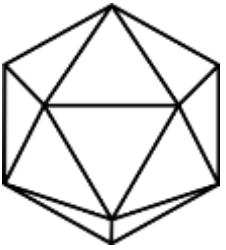
Artworks resulted from exploration of rotation groups in R^3

Kusudamas (Bolas de Flores)
Kusudama 12x5, Kusudama 20x3

Balls of Flowers Kusudama 12x5, Kusudama 20x3

Created & folded by Krystyna Burczyk, 2011





Exploration of the duality of polyhedra

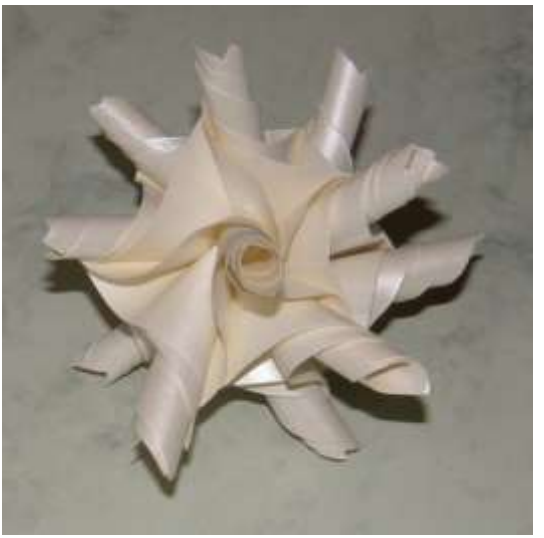
Orelhas de elefante - branco

Série: Gire Apenas!

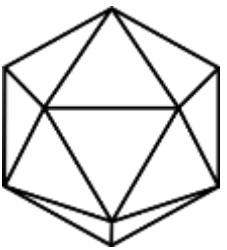
Elephant Ears – White

Serie: Just Twist

Created & folded by Krystyna Burczyk, 2009



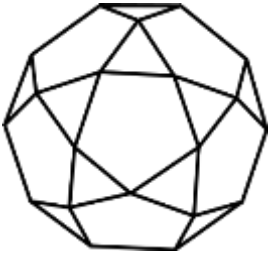
One module is like an edge of the icosahedron. 5 edges meet at the same vortex. But all modules meet at the center of the form. Paper knows what is a proper angle without counting and reading a book. It is not educated but well mannered.



Sopro

Puff

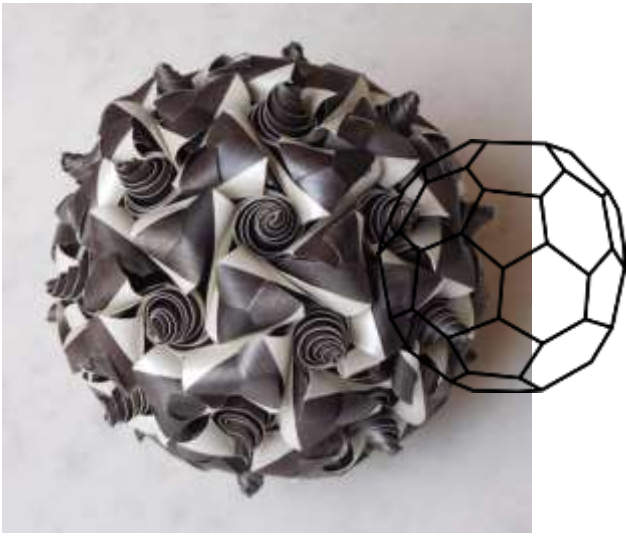
Created & folded by Krystyna Burczyk, 2009



Tesouro Escondido

Hidden Treasure

Created & folded by Krystyna Burczyk, 2016



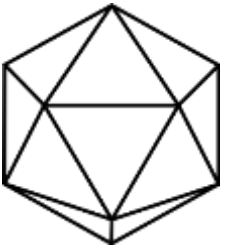
The structure is hidden, but it provides stability and shape of the artwork.

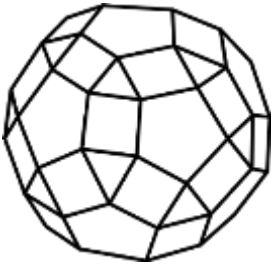
We can see triangles and vortexes. But what structure is hidden behind? The receipt is simple. Take a Buckyball, join centers of faces, add some paper, twist flaps and assemble pieces into final closed form.

Geodésicas: Icosaedro, Rombicosidodecaedro

Geodesics: The Icosahedron, The Rhombicosidodecahedron

Created & folded by Krystyna Burczyk, 2010



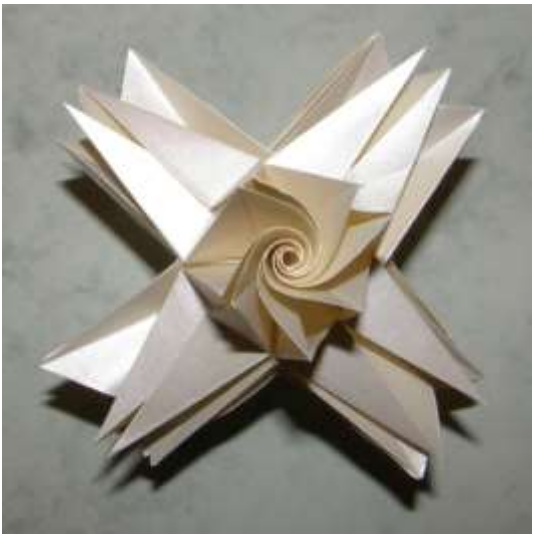


What does it mean "the shortest way"? On a sphere a part of a great circle is such a way. But what when a sphere has singularities with vortexes?

Triângulos Perpendiculares

Perpendicular Triangles

Created & folded by Krystyna Burczyk, 2010

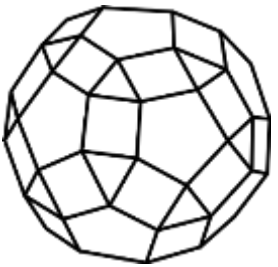


Then artwork is made of 12 edge modules. We join modules as the edges of the octahedron, but the edges aren't straight, they have 2 pairs of perpendicular triangles each.

Verão no Parque

Summer in the park

Created & folded by Krystyna Burczyk, 2012-17



Inverno num Parque em Lisboa

Winter in the park in Lisbon

Created & folded by Krystyna Burczyk, 2012-17

The artwork was placed at the cover of Revista de Ciência Elementar as an artistic vision of a virus.

Although needs and esthetic of humans and viruses are different, forces bounding smaller pieces into large stable structure result in surprisingly similar effects. Different types of bounds (either created by forces of paper or by chemical bounds between proteins), multiple similar elements, need of balance and stability lead to similar structures, both in a case of Twirls (as I call my origami artworks) in the macro-scale and, in case of viruses, in the micro scale.

Série “Aparas”

Serie: Pencil Shaving

Created & folded by Krystyna Burczyk, 2015

When we have a pencil or a crayon and use a sharpener, we cut a wooden part of the pencil into strips and create thin black waves.

The "shavings" series is a reference to childhood experiences when we used colored pencils and sharpening them was an important activity. The simplicity of this activity, the memory of it has been confronted with geometrical forms inaccessible to children's imagination.

Sonho de Mulher

Série “Aparas”

Woman’s Dream

Serie: Pencil Shaving

Created & folded by Krystyna Burczyk, 2015

Gente

Série “Aparas”

People

Serie: Pencil Shaving

Created & folded by Krystyna Burczyk, 2016

We can join in a chaotic way different modules, high, medium and low, into a unique form.

Vitral do Pôr do Sol

Série “Aparas”

Sunset Stained Glass

Serie: Pencil Shaving

Created & folded by Krystyna Burczyk, 2015

Mosaico – Mapa

Mosaic – Map

Created & folded by Krystyna Burczyk, 2013

Streets? Squares? Or only a network of connections? Turning points or irrelevant points? Finished form or incomplete one? Finite or boundless?

Mosaico – Sonhos

Mosaic – Dreams

Created & folded by Krystyna Burczyk, 2013

A regular network of simple, straightforward and earthbound connections together with arcs establishing distant connections. Real connections or just in our imagination?

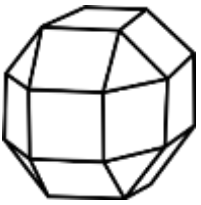
The regular network bounds. Is it possible to break these bonds. How to cross over bounding rules?

Vermelho Dentro de Branco

Red in White

Created & folded by Krystyna Burczyk, 2009

There is a red ball of 18 flowers inside the model (red) for stabilization all this structure made of strips which can exist alone as well. The artwork was placed at the cover of the proceedings of the OSME conference “Origami 5: Fifth International Meeting of Origami Science, Mathematics, and Education”, CRC Press, 2011



Funções

Functions

Artworks based on surfaces bounded by different functions.

Just an easy receipt: take a piece of a graph of any continues function (not necessary a smooth one) and a piece of the plane below this graph until x-axis. Make 30 paper pieces of such shape, twist and assemble. Now you can imagine a minimal-energy surface spanned over all ridges.

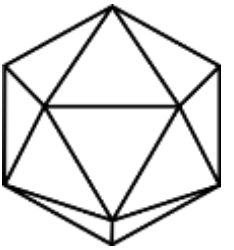
Icosaedro

Icosahedron

Icosaedro Truncado

Trucated Icosahedron

Created & folded by Krystyna Burczyk, 2010-2011

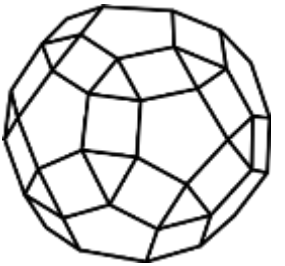


Vigilância

Surveillance

Created & folded by Krystyna Burczyk, 2015

A headphones module has 4 spirals and it corresponds to an edge of the rhombicosahedron. This polyhedron has a symmetric structure, but the ball has a different symmetry. What happened?



Microfone

Microphone

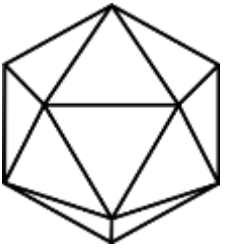
Created & folded by Krystyna Burczyk, 2015

Only paper and physics know what is a structure of this ball! Only squares? Only rhombuses?

Vejo-te

I Can See You

Created & folded by Krystyna Burczyk, 2015



Asas de Anjo

Angel Wings

Created & folded by Krystyna Burczyk, 2012

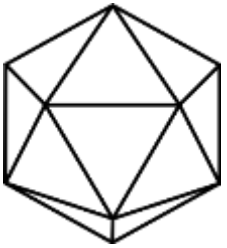
There is a cake in Poland, which is made from a rectangular strip of thin dough with a straight cut in the middle parallel to the long side. We can turn the strips on both sides of the cut by passing one end of the strip through the hole.

Hibrido

Hybrid

Created & folded by Krystyna Burczyk, 2015

Paper and 3D print. Why not?

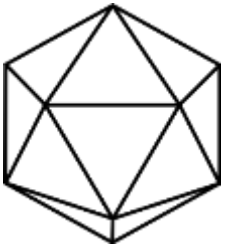


Hibrido – Nas Grilhetas

Hybrid – Shackled

Created & folded by Krystyna Burczyk, 2015

Paper and aluminum. Why not!

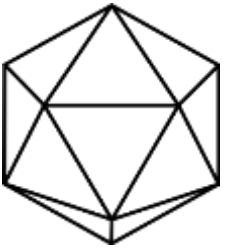


Parque aquático

Water Park

Created & folded by Krystyna Burczyk, 2015

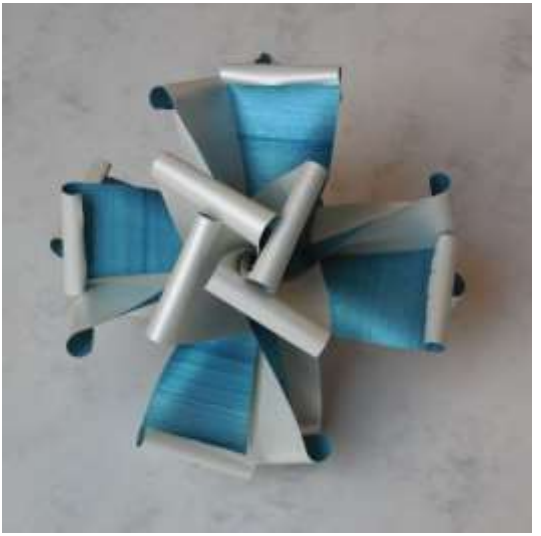
Thirty trampolines to jump inside the water! Twenty small lakes and twelve dangerous vortexes! And corridors joining peaks of the water icosahedron.



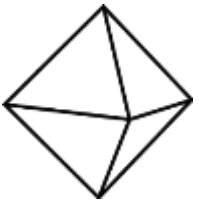
Cruz de Malta

Maltese Cross

Created & folded by Krystyna Burczyk, 2016

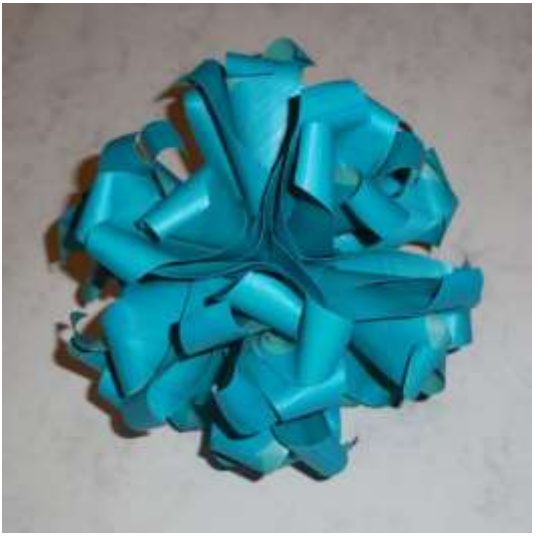


Is it based on the structure of the cube or the octahedron? Or it does not matter?

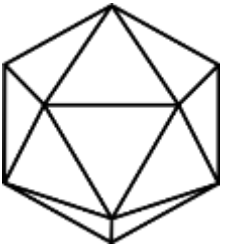


Bahamas

Created & folded by Krystyna Burczyk, 2015



Fold waves and use triangles to prepare this icosahedral structure. See pentagons and dodecahedral structure inside.



Juntos!

Together

Created & folded by Krystyna Burczyk, 2015

I do not use any calculator to twist spirals. Sometimes I have problems how to join. I know the structure and positions of all modules but sometimes I must repeat joining several times. When spirals are really small physics verifies work of paper and the paperfolder.

Harmónios

Série: Metamorfoses

Accordion folds

Series: Metamorphoses

Created & folded by Krystyna Burczyk, 2006

Artworks result from exploration of the discrete parametrization. Divide the central square in a rectangle 2 x 1 into strips that fold into accordion shape and resulting points form a curve. Theoretically we may increases the number of strips to infinity. What curve become a limit of such sequence? And does the answer depend of the properties of the paper?

Gire Apenas!

Just twist

Is it still origami or already another art of transformation of paper into 3D forms? Separate units do not have any single crease line. What keeps them together is mathematics (the structure), physics (friction), paper (elasticity). If any of these components is missing everything would fall apart.

This series of artworks resulted from the investigation of the problem of minimal origami construction. How many creases can we remove to have still an origami object? The effect is completely surprising as we do not need any fold at all.

Bola de Pétalas de Rosa

Rose Petals Ball

Created & folded by Krystyna Burczyk, 2010

An artwork of Just Twist series. Rose flowers (pentagonal stars) aren't necessary, but have made the form stronger (it is an example of simple application of the triangulation of a polyhedron as the snub dodecahedron is a base of the artwork).

Simbiose

Symbiosis

Created & folded by Krystyna Burczyk, 2018

Eternidade

Eternity

Created & folded by Krystyna Burczyk, 2016

“Acimaixo”– Acima e baixo

“Uplower” – Upper and Lower

Created & folded by Krystyna Burczyk, 2009

Artwork results from exploration of structural duality. The same basic modules, the same structure (dodecahedron), but difference in the joining process – the modules are rotated and different type of spirals come to the pentagonal vortex.