30th Anniversary of Visgraf

01/11/2019

EVENT SCHEDULE

Poster Section | 9 a.m to 6 p.m
Poster exhibition of Visgraf Lab Members and Former Members

Welcome | 2 p.m.
Welcome section

Round table* | 2:30 p.m.
Round table with current Laboratory researchers, Luiz Velho, Luiz Henrique de Figueiredo and Diego Nehab, Jonas Gomes and Paulo Cezar Carvalho

Cocktail | 3 p.m.

**the round table will be broadcast live on IMPA's youtube channel*

Website
http://bit.ly/visgraf30

Visgraf 30 ANOS

VisgrafLab

impa

Visgraf Vision and Graphics Laboratory

visit visgraf website:
www.visgraf.impa.br

Visgraf Vision and Graphics Laboratory

highlights

news

Julia Giannella talks about Data Visualization at event In.Rio 2017

instagram

Visgraf 30 ANOS

10:23

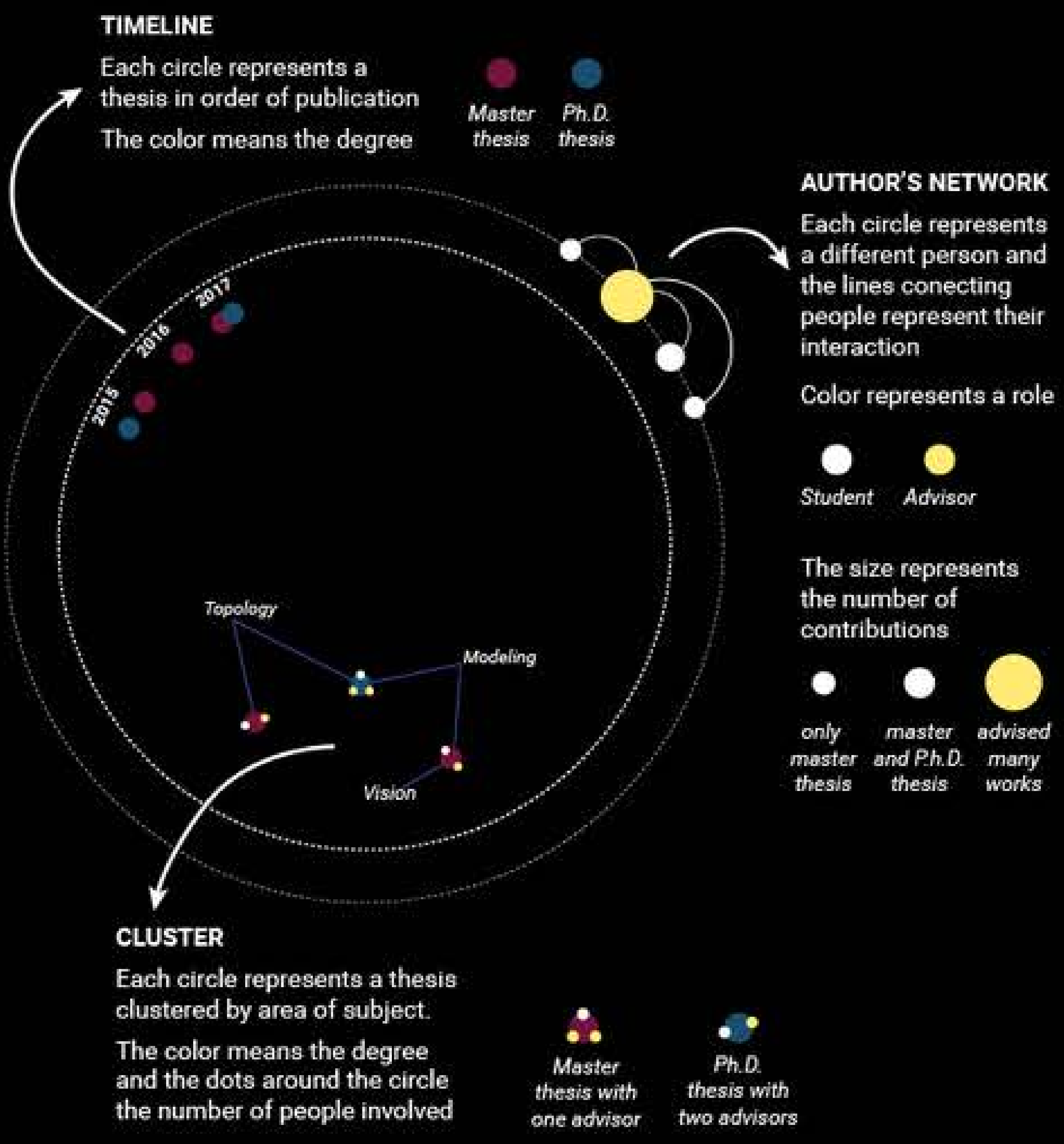
visit visgraf website:
www.visgraf.impa.br

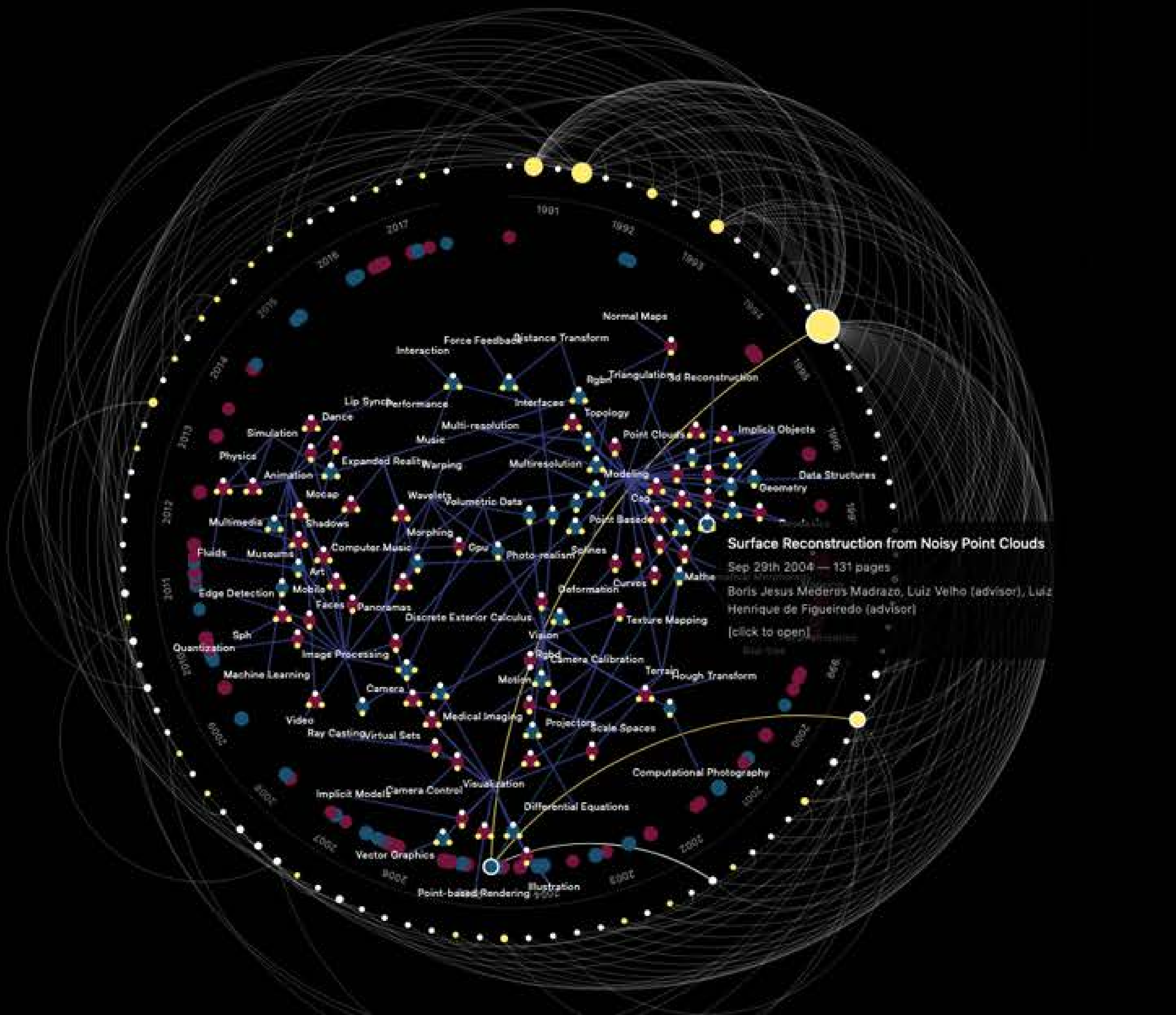
Visgraf's theses database

A visual exploration of the Master and Ph.D Theses elaborated at the Vision and Computer Graphics Laboratory (Visgraf-IMPA) from 1990 to 2017.

This visualization is best viewed in 1024x768 resolution.

Master Theses | All Theses | Ph.D. Theses





First Visgraf paper at SIGGRAPH

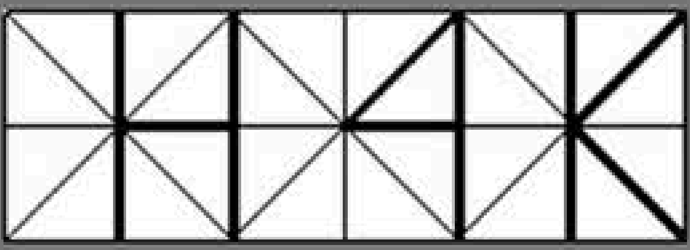
Computer Graphics, Volume 25, Number 4, July 1991

Digital Halftoning with Space Filling Curves

Luiz Velho*
Jonas de Miranda Gomes

dithered image

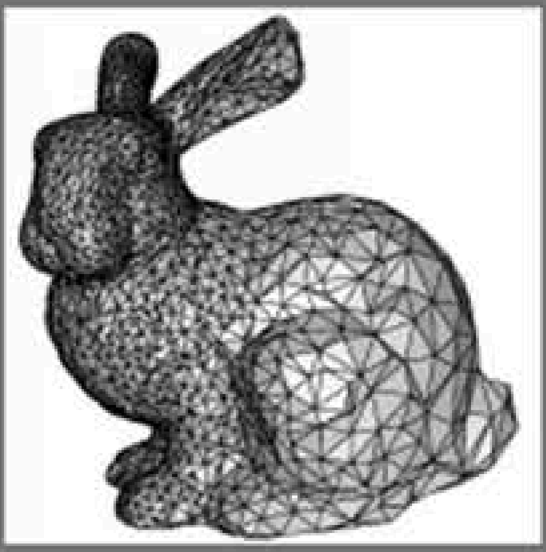
Hierarchical 4-K Meshes

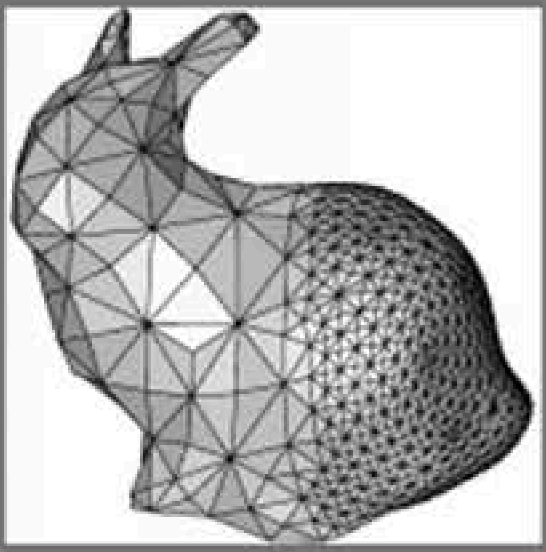


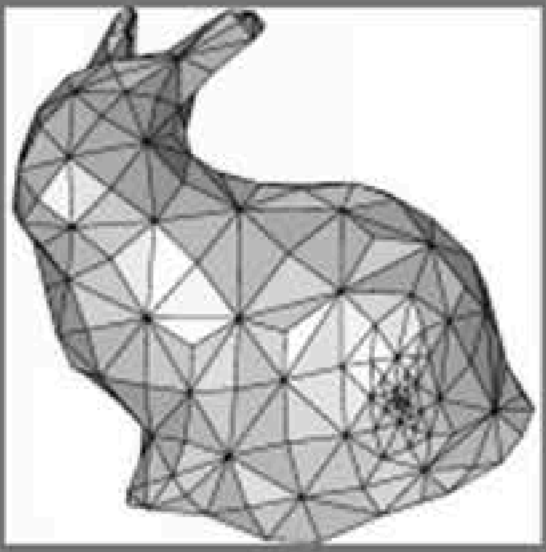
Hierarchical 4-K Meshes constitute a powerful framework for variable-resolution representation of surfaces, as well as, for adaptive computations on 2D manifolds. The framework is integrated by a data structure, together with a set of procedures that operate on it.

We have developed methods for constructing 4-K meshes based on subdivision, adaptive refinement, and simplification. We have also implemented operators for mesh extraction, interrogation and conversion to other representations.

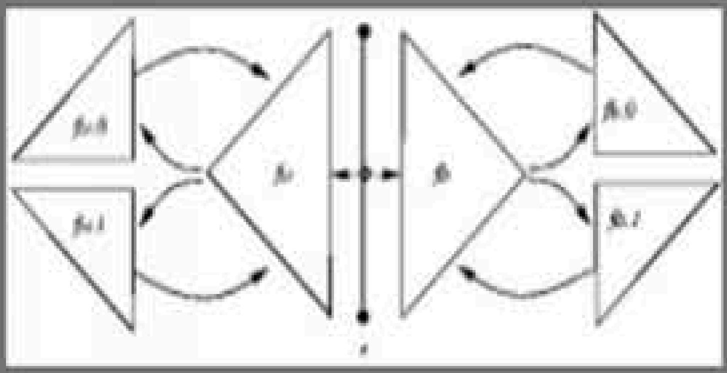
The figures below illustrate the expressiveness of the 4-K structure. These meshes conform to various adaptation criteria, including: gradual change in resolution; region segmentation; and point location. We used simplification (left) and subdivision (center, right) to generate the underlying hierarchical structures.







Papers



Variable Resolution 4-K Meshes:
Concepts and Applications
(Computer Graphics Forum, 2000)

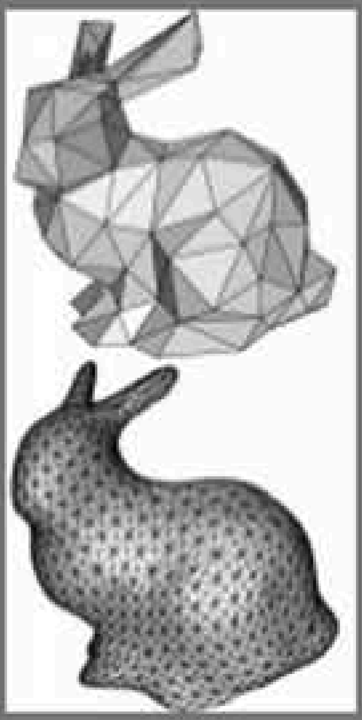
This paper describes the variable-resolution 4-K data structure. It also gives an overview of construction methods, including: subdivision, refinement and simplification.

Projetos de pesquisa antigos

Visgraf 30 anos

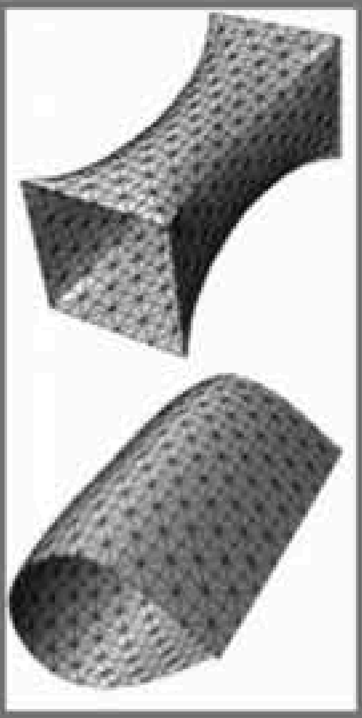
4-8 Subdivision

Papers



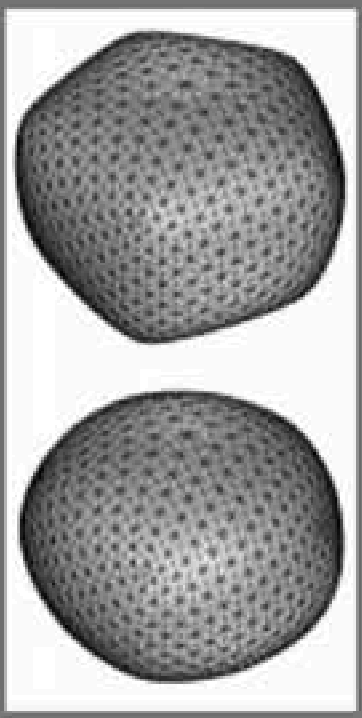
4-8 Subdivision
(CAGD 2001, Special Issue on Subdivision)

This paper extends four direction box splines to irregular triangle meshes. It presents a semi-regular 4-8 refinement procedure and a generalization of a box spline which is C4 continuous almost everywhere.
(See also Generalizing the C4 Four-directional Box Spline to Surfaces of Arbitrary Topology , *Mathematical Methods in CAGD: Oslo 2000*.)



Quasi 4-8 Subdivision Surfaces
(CAGD 2001)

This paper investigates the concept of quasi-stationary subdivision arising from geometry-dependent refinement. It also proposes a factorization of high order subdivision schemes through repeated convolution.



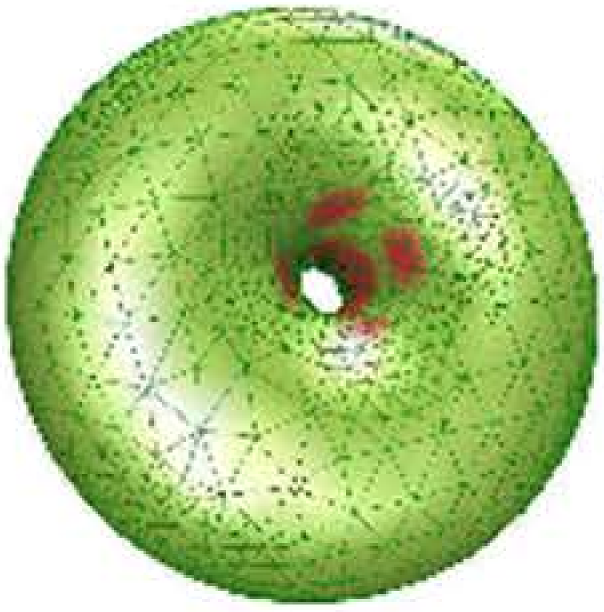
Using Semi-Regular 4-8 Meshes for Subdivision Surfaces
(Journal of Graphics Tools, 2000)

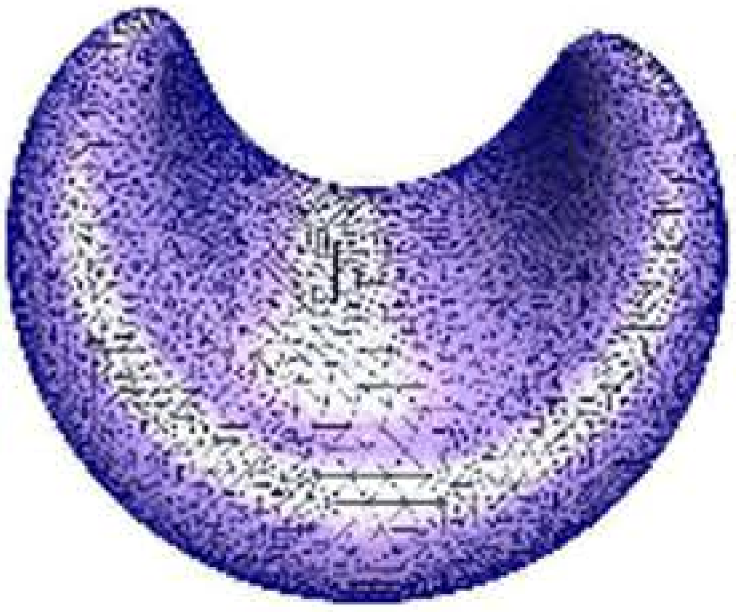
This paper shows how to implement the Catmull-Clark and Doo-Sabin subdivision surfaces using 4-8 meshes. This method is based on a decomposition of the corresponding subdivision operators.

Interval methods for computer graphics and geometric modeling

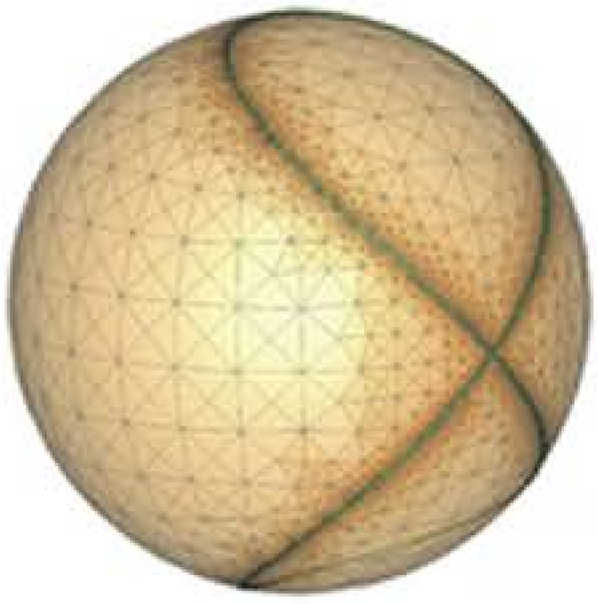
This research focuses on robust and adaptive methods for the solution of problems in computer graphics and geometric modeling. Robustness means that we are interested in using computers to prove properties of curves and surfaces. This usually takes the form of solving equations in several variables. The main tools for achieving robustness are interval computation methods using interval arithmetic and affine arithmetic. Interval methods provide guaranteed numerical results that are not affected by rounding errors in floating-point computations. More importantly, interval methods allows us to analyse the global behaviour of functions over whole regions of the space without sampling it. Adaptiveness means that we want to concentrate the computational effort near interesting regions of the space, such as near a solution curve or in regions where the surface curvature is high. Global analysis with interval methods leads naturally to adaptive methods.

adaptive meshes for implicit surfaces

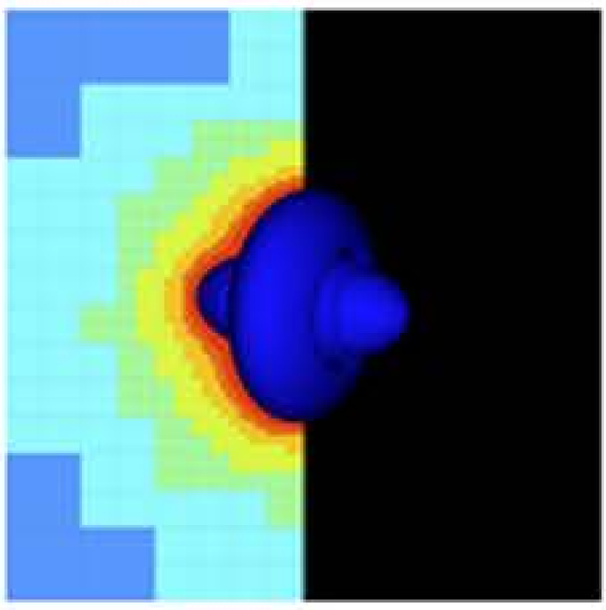




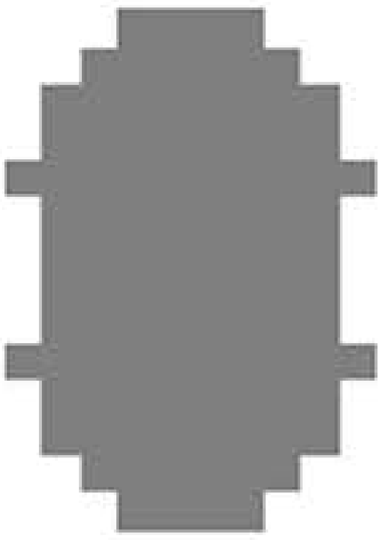
implicit curves on triangulations



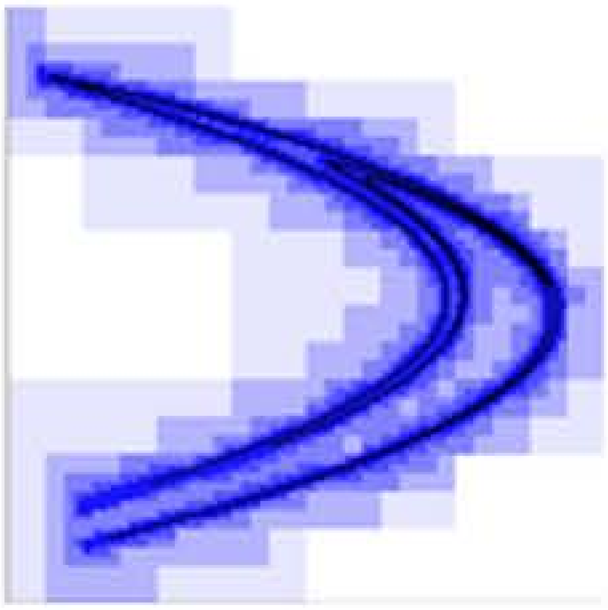
beam casting implicit surfaces



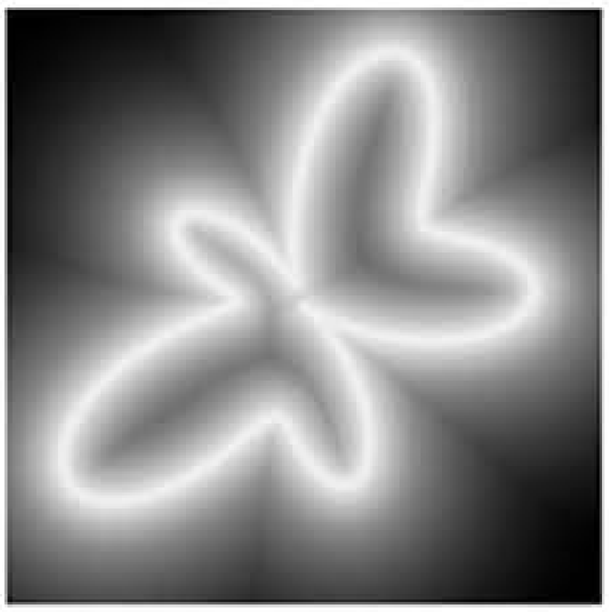
bounds for Julia sets



bounds for strange attractors



distance fields for parametric curves

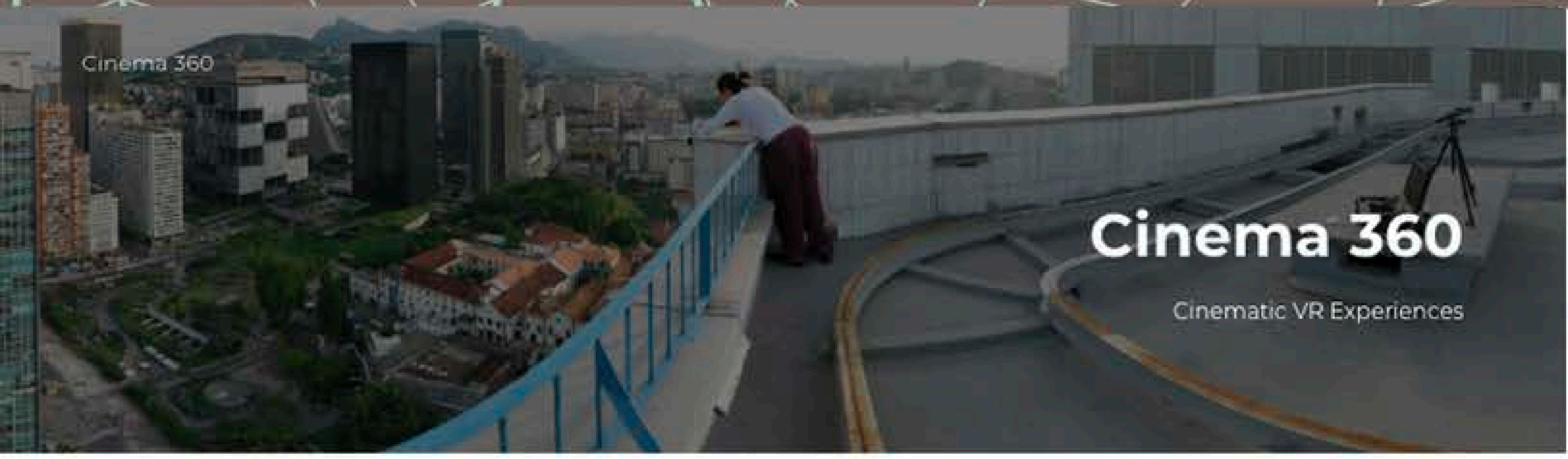


strip trees for parametric curves

offsets of parametric curves

Projetos de pesquisa atuais

Visgraf 30 ANOS

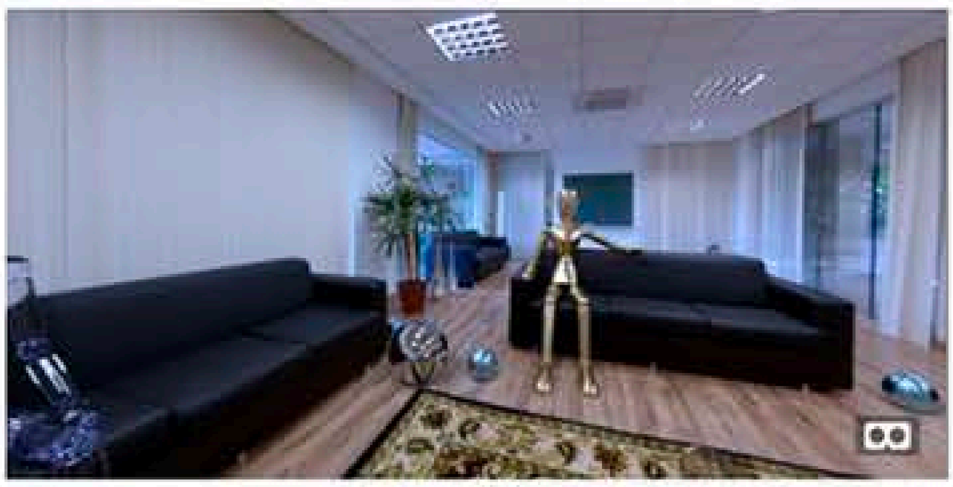


About

Cinema 360 is a line of research that expores new possibilities for cinematic 360 VR experiences. That includes novel forms of visualization, narrative and interaction.

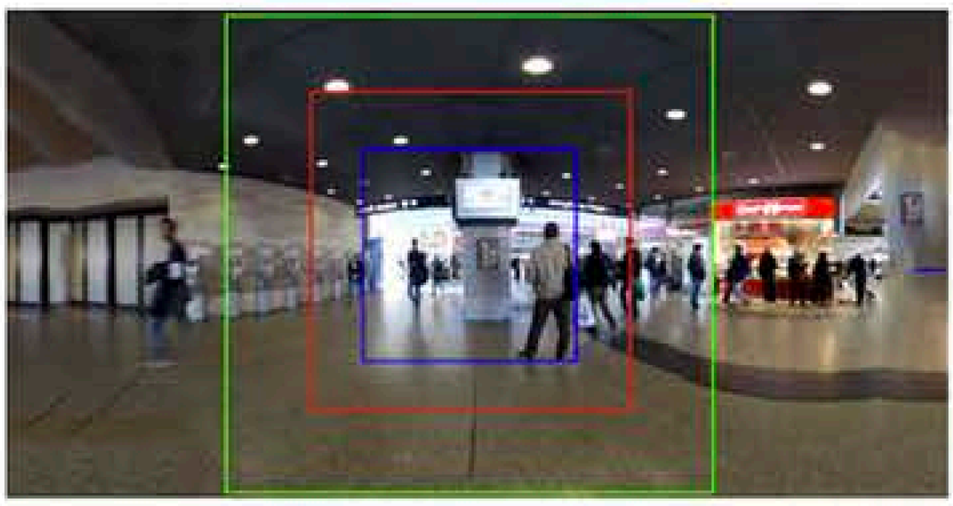
Expanded Panoramas

This project aims to create new, richer and unique experiences for each user; and allows to explore properties inherent to three-dimensional visualization, such as: view dependent lighting effects, and parallax effects, that enrich the user experience.



Moebius Transformations for 360 Imagery

The project proposes Moebius transformation on videos as a mathematical formulation more appropriate to operate in spheric functions and, as a consequence, resulting in natural tools for editing and visualization of omnidirectional images.



Gaze-Based Interaction

360 VR Gaze-Based Interaction is a platform for creation of interactive omnidirectional cinematic content for Virtual Reality such that the viewer center of interest guides the narrative.

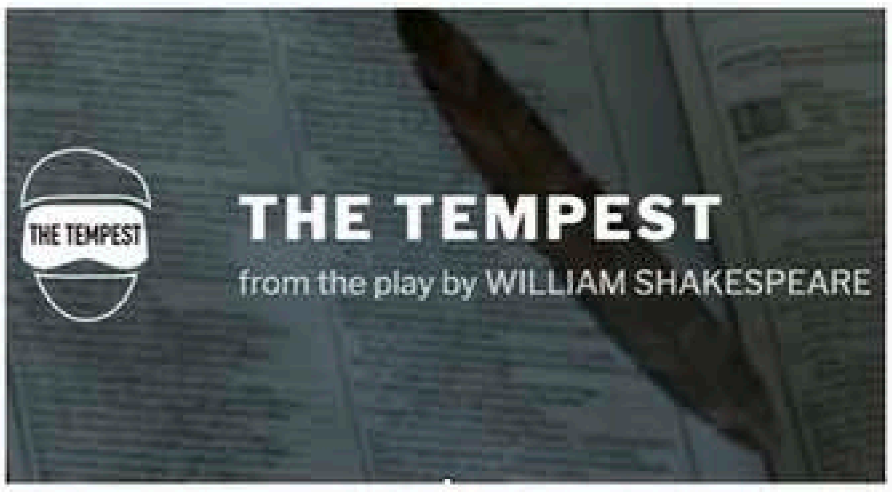
Projetos de pesquisa atuais

Visgraf 30 ANOS

New Media

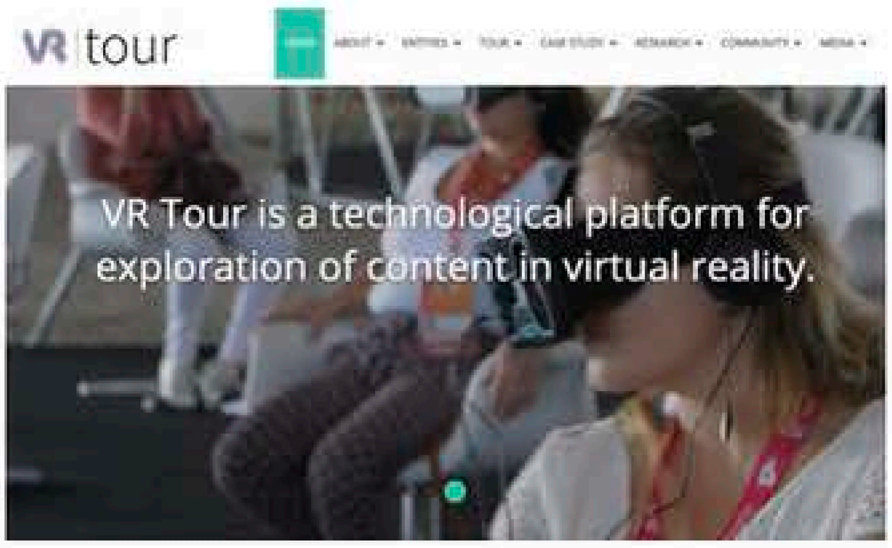
The Tempest

The Tempest is an experiment based on the Shakespeare's play combining theatrical performance with live cinema using virtual reality and gaming technologies.



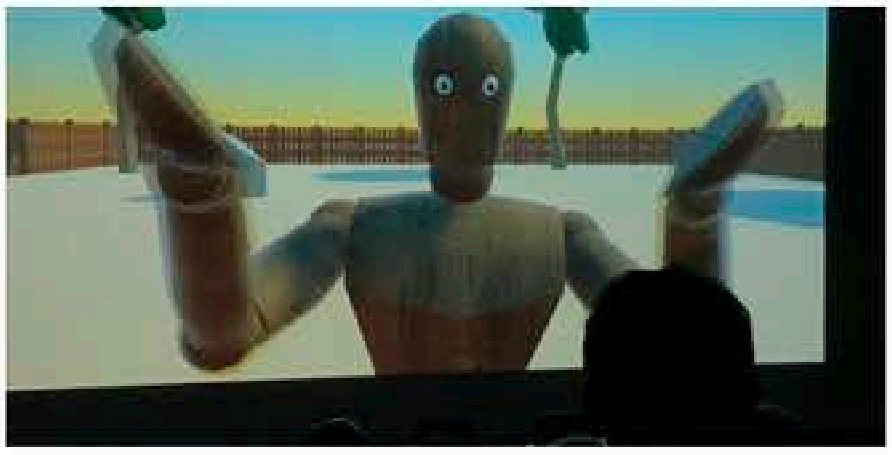
After The Tempest

After the Tempest is an experiment based on The Tempest, the Shakespeare's play. It was created to demonstrate the concept of VR Tour and test the platform



Lilith and Wood

"Aventuras de Lilith e Wood" was produced as part of the research in New Media, that combines puppet theater in virtual reality with interactive narratives. The experiment is the result of a scientific-creative partnership with a focus on storytelling, multilingualism and contemporary themes.

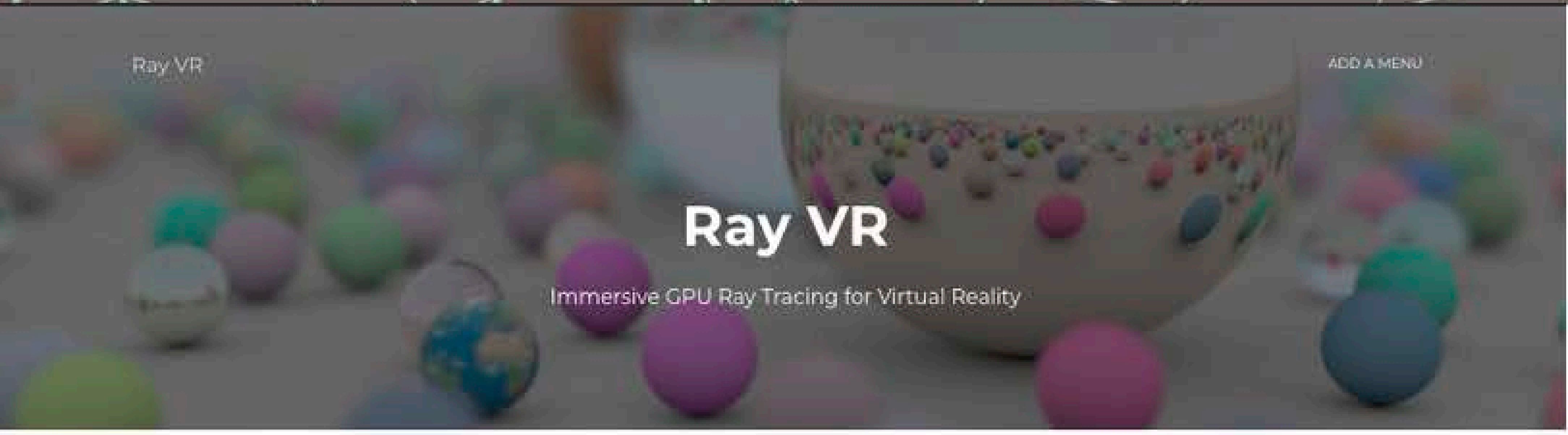


Searching for Aloyo

Aloyo, a twelve years-old girl living in Lira, Uganda, sits among other children around the fire to tell their story during war, what they saw, where they went. CHILDREN DO NOT PLAY WAR narrates the memories, dreams and daily lives of the children who returned from the war and about how they recovered their childhood.

Projetos de pesquisa atuais

Visgraf 30 ANOS



Ray VR

ADD A MENU

Ray VR

Immersive GPU Ray Tracing for Virtual Reality

About

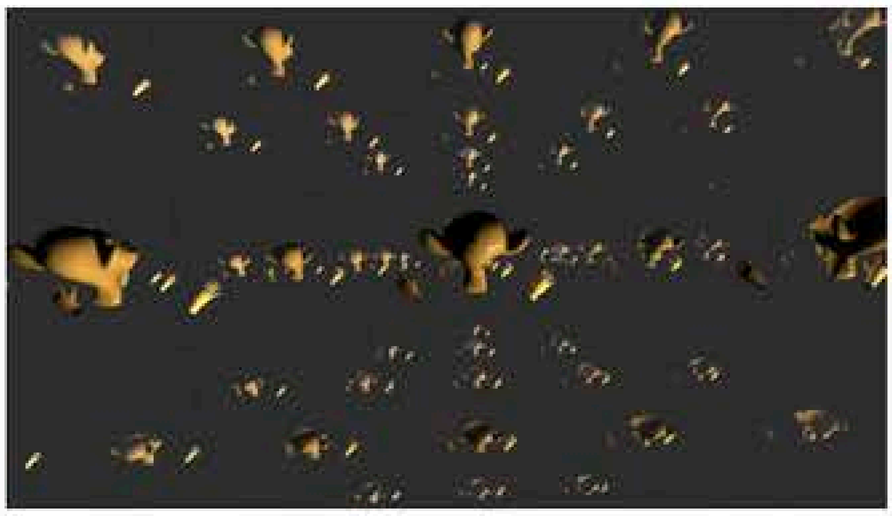
This project investigates the use of recent capabilities of modern GPU's that implement Ray Tracing in real-time . It combines those features with Virtual Reality to explore new forms of immersive visualization and interaction.

Ray Tracing Virtual Reality

Ray-VR is a novel platform for real time stereo ray tracing, constructed on top of Falcor, NVidia's scientific prototyping framework. Ray-VR performance is very flexible. It can adapt a VR experience to different hardware constraints and is also totally compatible with current VR creation workflow.

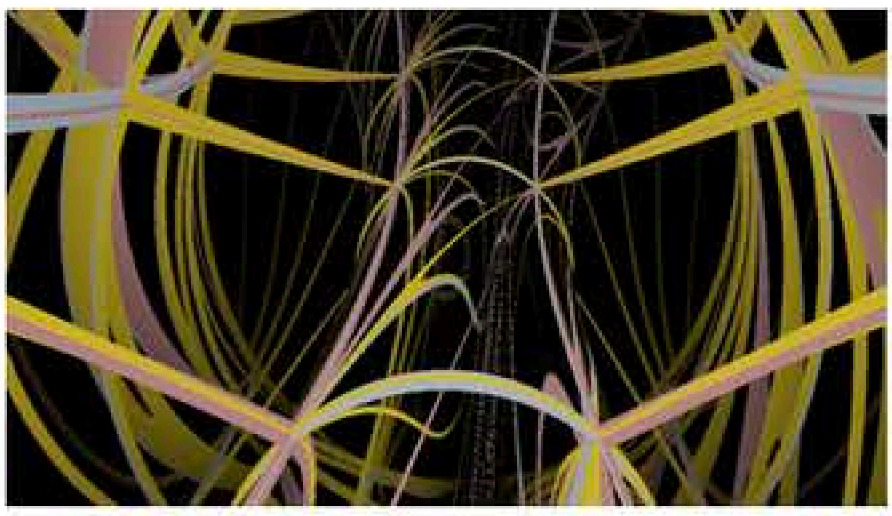
Visualization of Classical Non-Euclidean Spaces

The project exploits the power of the new generation of GPU's based on the NVIDIA's Turing architecture in order to develop new methods for intuitive exploration of landscapes featuring non-trivial geometry and topology in virtual reality.



Visualization of Nil and Sol

A look into two of the most beautiful and intriguing spaces among the eight Thurston geometries.



/visgraflab @visgraflab @visgraflab

impa

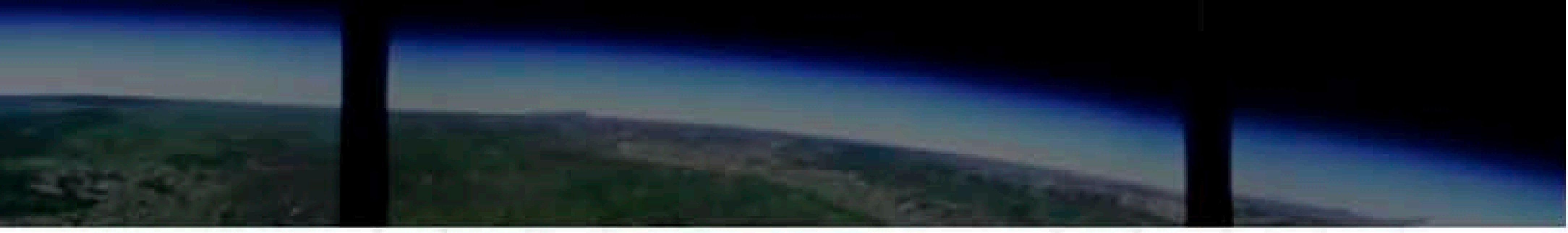
Projetos de pesquisa atuais

Visgraf 30 anos

MENU

ACORDO DE COOPERAÇÃO

IMPA+IMS



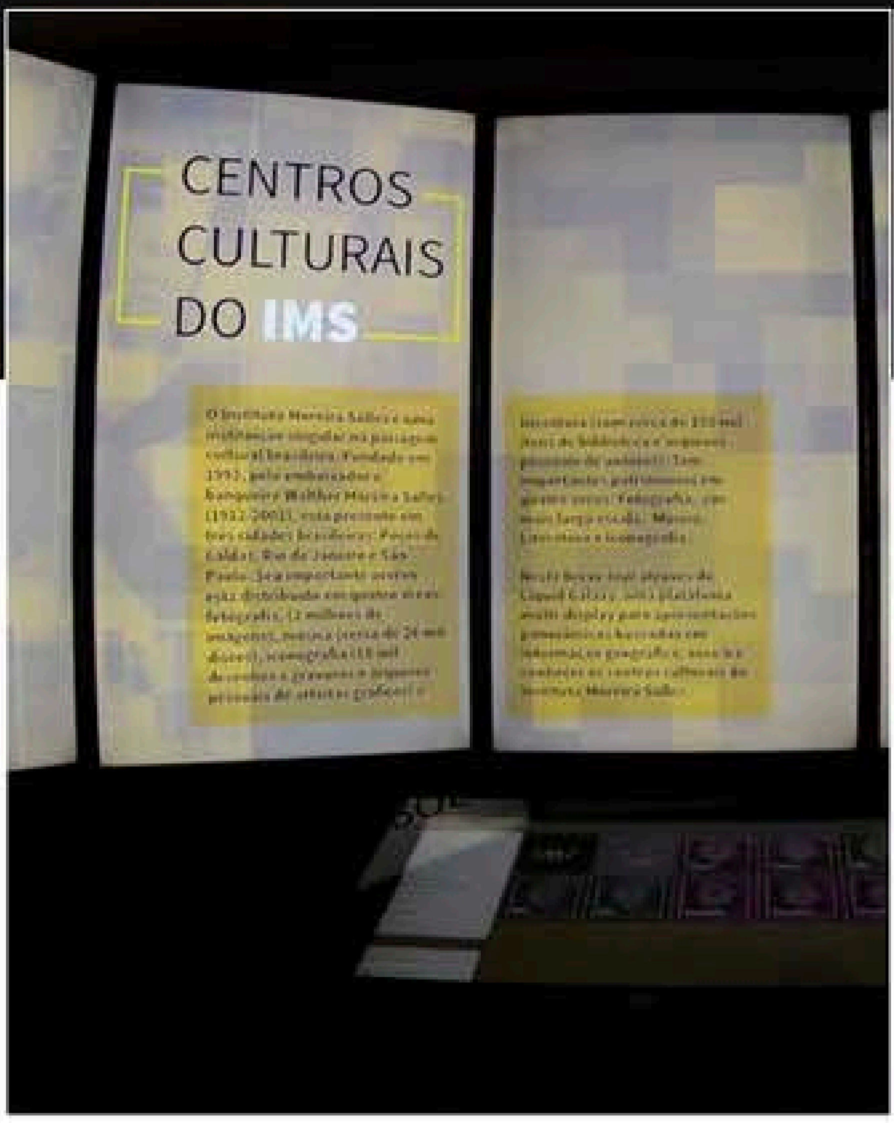
FRENTES DE PESQUISA

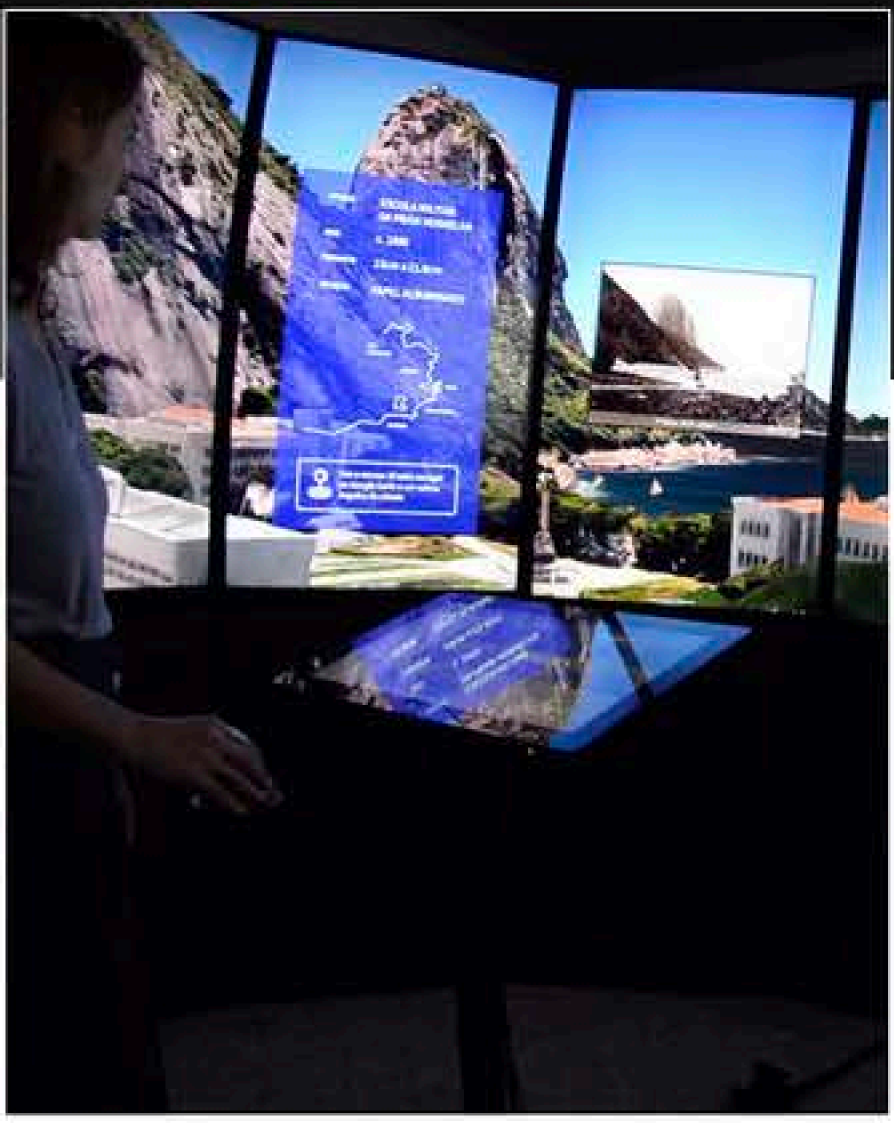
Os interesses de pesquisa concentram-se em quatro eixos:

- Tecnologias e mídias para bancos de imagens
- Plataforma Liquid Galaxy
- Georreferenciamento de fotografias urbanas
- Mapeamento de outras tecnologias

PRODUTOS

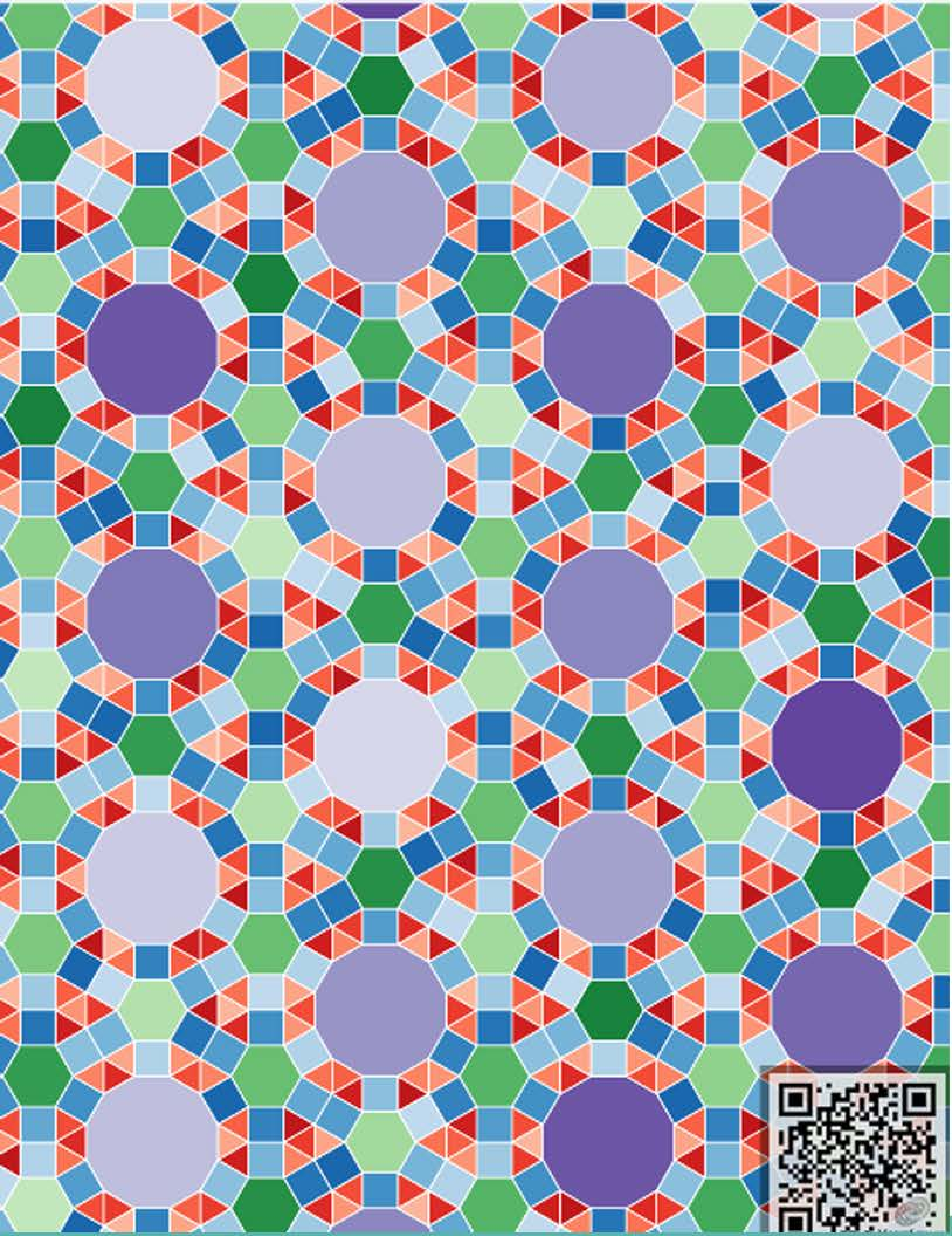
Protótipos de visualização na plataforma Liquid Galaxy





Periodic Tilings of Regular Polygons

Asla Medeiros e Sá   José Ezequiel Soto Sánchez   Luiz Henrique de Figueiredo



Trabalhos de alunos do Visgraf

Visgraf 30 anos

INTERVAL NUMERICAL METHODS FOR FIXED POINTS

José Eduardo de Almeida Ayres · Luiz Henrique de Figueiredo

Finding the fixed points of a function is important in many contexts. For instance, solving nonlinear equations is frequently cast as finding fixed points. Newton's method is probably the main example of this formulation. Fixed points, and more generally periodic points, are also important in discrete dynamical systems, especially in complex dynamics, where periodic orbits play a key role. There is a large literature on interval methods for solving nonlinear equations, but surprisingly very little that is specific to fixed points.

Let $f : \Omega \subseteq \mathbb{R}^d \to \mathbb{R}^d$ be a continuous function defined on a box Ω. We describe a rigorous numerical method based on interval analysis for finding all fixed points of f: attracting, repelling, and indifferent. We specialize this method for finding all attracting periodic points of a complex polynomial.

Our algorithm is a divide-and-conquer algorithm that recursively subdivides Ω and discard boxes that cannot contain a solution to isolate fixed points within a given tolerance ε. Our algorithm is both spatially adaptive, because its search is guided by the location of the fixed points of f, and analytically adaptive because its search is also guided by the nature of the fixed points of f.

Interval analysis is the main tool for rigorous numerical computation. It is based on interval arithmetic, an extension of ordinary arithmetic operations and standard elementary functions to intervals. The basic fact in interval analysis is that for each function $f : \Omega \subseteq \mathbb{R}^d \to \mathbb{R}$ expressed by a formula or an algorithm, there is a computable function F automatically built from the expression of f, called the natural interval extension of f, such that $F(X)$ is an interval that estimates the whole range of values taken by f on a box $X \subseteq \Omega$:

$$F(X) \supseteq f(X) = \{f(x) : x \in X\}$$

Finding the exact range $f(X)$ is a hard problem in general. Therefore, the inclusion $F(X) \supseteq f(X)$ is usually proper and interval estimates are usually overestimates. Nevertheless, the estimates $F(X)$ get better as X shrinks to a point in the sense that $F(\{x\}) = \{f(x)\}$ for every $x \in \Omega$. More precisely, we have at least linear convergence for interval estimates: $\operatorname{diam}(F(X)) \leq c \operatorname{diam}(X)$ for some c that depends only on f. Thus, interval methods are typically divide-and-conquer methods that recursively explore the domain of f, getting better information about f as they refine the subdivision, and discarding boxes that cannot contain a solution. For instance, when finding the zeros of f in Ω, we can discard a box X whenever $0 \notin F(X)$. This is a computational proof that f has no zeros in X. However, because of overestimation, we cannot conclude that f has a zero in X when $0 \in F(X)$. In this case, we subdivide X and recursively test the pieces.

Automatic differentiation is the perfect companion for interval arithmetic and works in a similar fashion. It automatically converts an expression for f into an algorithm that simultaneously computes the value of f and of all its partial derivatives. When fed intervals instead of numbers, this algorithm computes interval estimates for the value of f and of all its partial derivatives. This allows us to reason reliably about both the range of values of f and its regions of monotonicity.

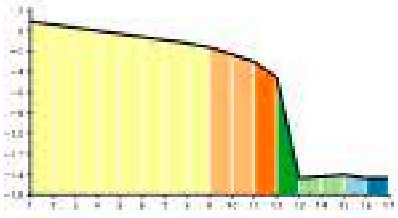
Interval arithmetic and automatic differentiation allow us to check the hypotheses of the fixed-point theorems rigorously in a computer. The existence of fixed points in a box X guaranteed by Brouwer's theorem follows whenever $F(X) \subseteq X$ because then $f(X) \subseteq F(X)$ implies $f(X) \subseteq X$. The existence of a unique fixed point in a box X guaranteed by Banach's theorem follows whenever $F(X) \subseteq X$ and $\|F'(X)\| < 1$ because these imply that f is a contraction in X, thanks to the mean value inequality. Here, F' is an interval extension of the Jacobian matrix of f, which can be computed with automatic differentiation.

ALGORITHM

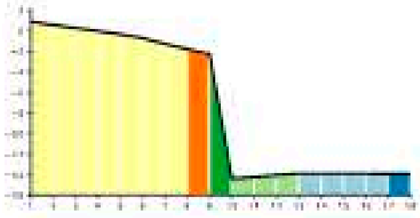
procedure Explore(X)
  $W, W' \leftarrow X, 1$
  for $k = 1$ to n **do**
    $W, W' \leftarrow F(W), F'(W)W'$
    if W is outside the escape disk **then**
      discard X
    end
  end
  $X' \leftarrow X \cap W$
  if $X' = \varnothing$ or $\|W'\| \geq 1$ **then**
    discard X
  else if $\operatorname{diam}(X') < \varepsilon$ **then**
    accept X'
  else if $W \subseteq X$ and $\|W'\| < 1$ **then**
    ExploreAttracting(X')
  else if $\operatorname{diam}(X') < \lambda \operatorname{diam}(X)$ **then**
    Explore(X')
  else
    SubExplore(X')
  end
end

procedure ExploreAttracting(X)
  $\hat{x} \leftarrow \operatorname{mid}(X)$
  repeat
    $\hat{x} \leftarrow f^n(\hat{x})$
  until convergence
  $X \leftarrow [\hat{x}, \hat{x}]$
  repeat
    $X \leftarrow$ Inflate(X)
  until $F^n(X) \subseteq X$
  repeat
    $X \leftarrow F^n(X)$
  until convergence
  accept X
end

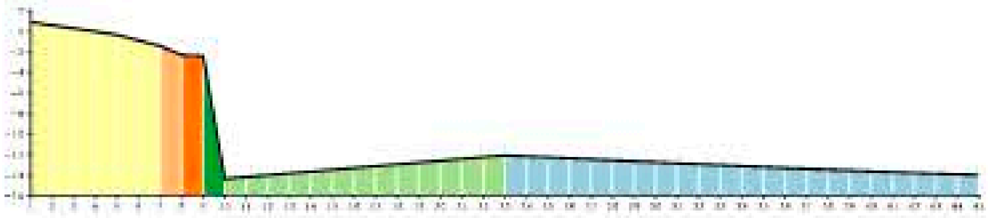
PERFORMANCE



super attracting point

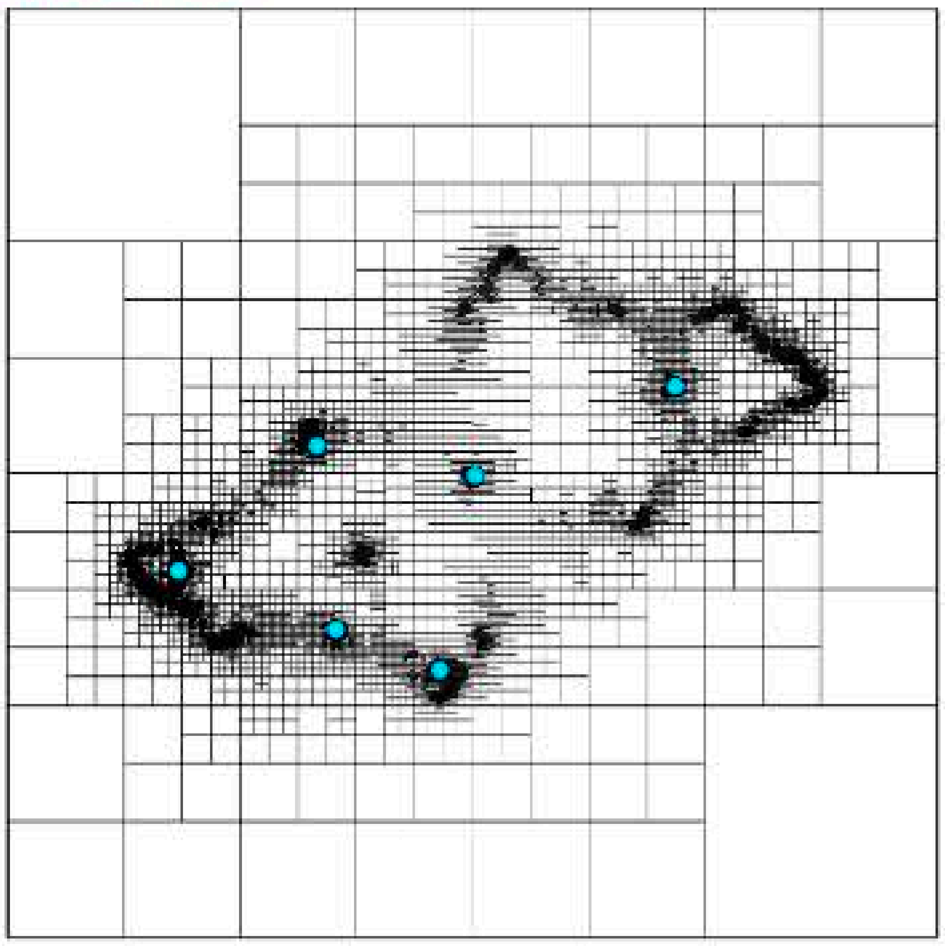


strongly attracting point



weakly attracting point

CONVERGENCE



ACKNOWLEDGEMENTS The first author is partially supported by CNPq and FAPERJ doctoral scholarships. The second author is partially supported by a CNPq research grant. This research was done in the Visgraf Computer Graphics laboratory at IMPA. Visgraf is supported by the funding agencies FINEP, CNPq, and FAPERJ, and also by gifts from IBM Brasil, Microsoft, NVIDIA, and other companies.

Deep Reinforcement Learning
High-Level Character Control

Caio Souza

Deep Reinforcement Learning have been successfully applied to various tasks from 2D Atari games to low-level control of bipeds in simulated physics environments. Learning in 2D environments with visual observations achieved superhuman results, yet there is a lot to explore in 3D without using hand-crafted features.

Figure 1: Tasks successfully solved with deep reinforcement learning. (Left) DeepMind solving Atari 2D games with visual observation, (Center) Deeploco, learning physics-based locomotion skills with low level (joints and forces) control-sensing, (Right) Our Rubik's cube direct solver without pattern match or search algorithms.

Completely solving the learning problem for the 3D real world would be equivalent to solve the Computational Vision problem at least on a implicit level, (having an implicit understanding of the world through vision and acting according). While this is far ahead of current knowledge, developing solutions for controlled 3D environments simulated on computers are a step in the direction of this general task.

Our intend is to research on high-level planning in a 3D simulated environment. Instead of learning low-level tasks, like standing up or walking on a physics accurate simulation, and then hand-coding the high-level behaviors, we start with a character which already "knows" how to walk, run or jump and we want to learn more high-level tasks for example collecting/avoiding a given object. Everything is done through visual sensing and no other environmental information like position, speed, distance to the objective, etc.

Although it is a small subset of a broader problem, it has many application for Non-Playable-Characters. Having such characters capable of making high-level decisions and later on, interacting with people in a virtual environment through a game or a VR experience can bring new possibilities to extend artistically and creatively our storytelling tools.

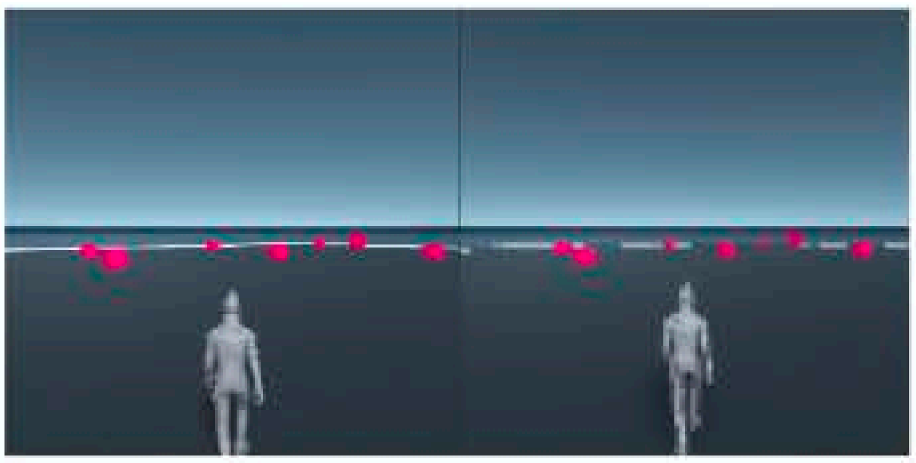


Figure 2: Early experiments with visual sensing, strictly controlled: color differentiating border and collectible objects. (Left) Unity 3D environment where the character is trained to collect the colored objects. (Right) Sample image which is used as visual observation.

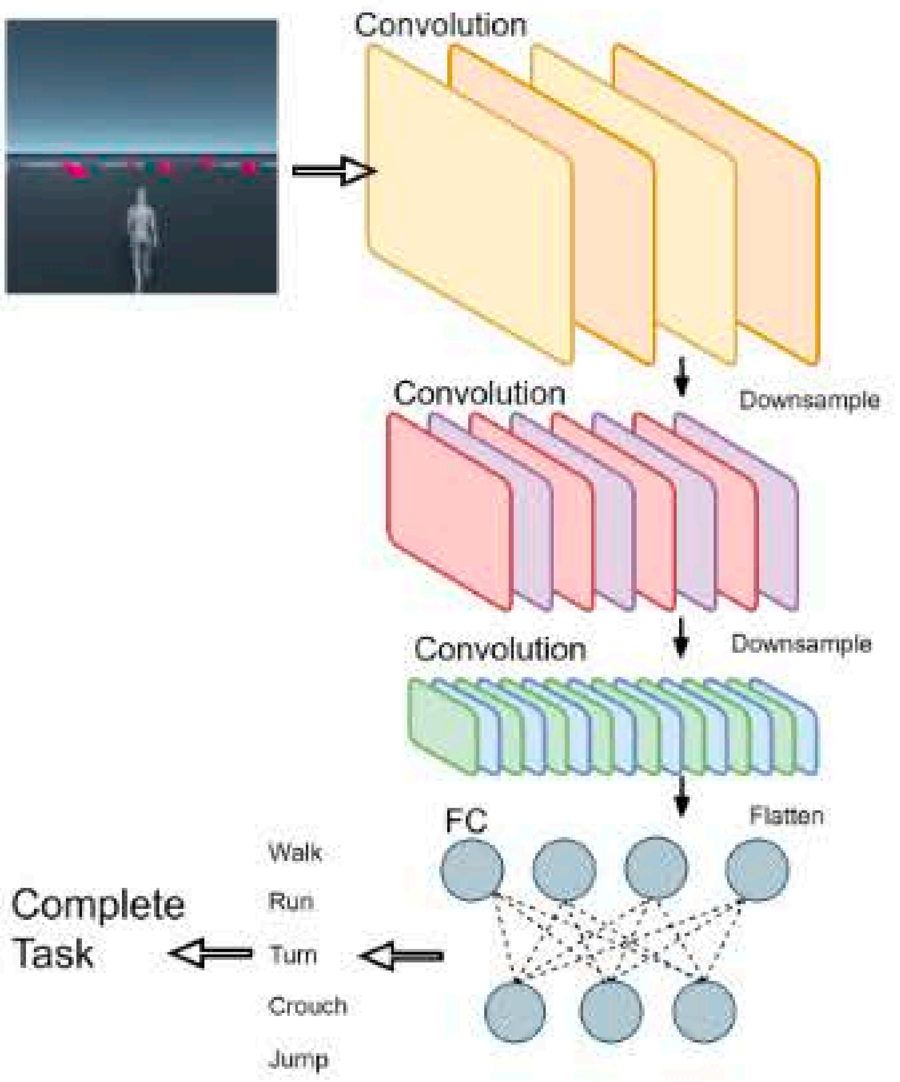


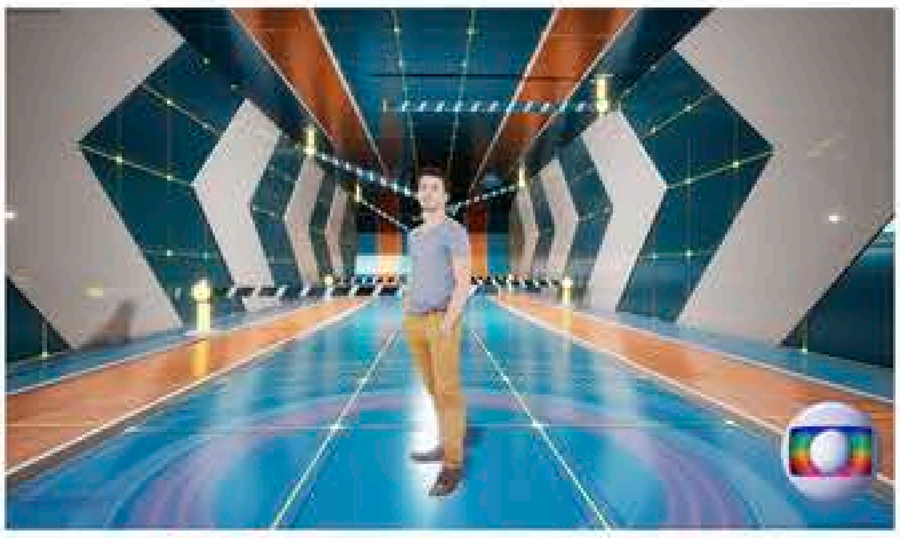
Figure 3: Illustration of a architecture which takes raw visual input, extract features through convolutional and pooling layers and output a step-by-step decision from fully-connected layers to complete a bigger task through time.

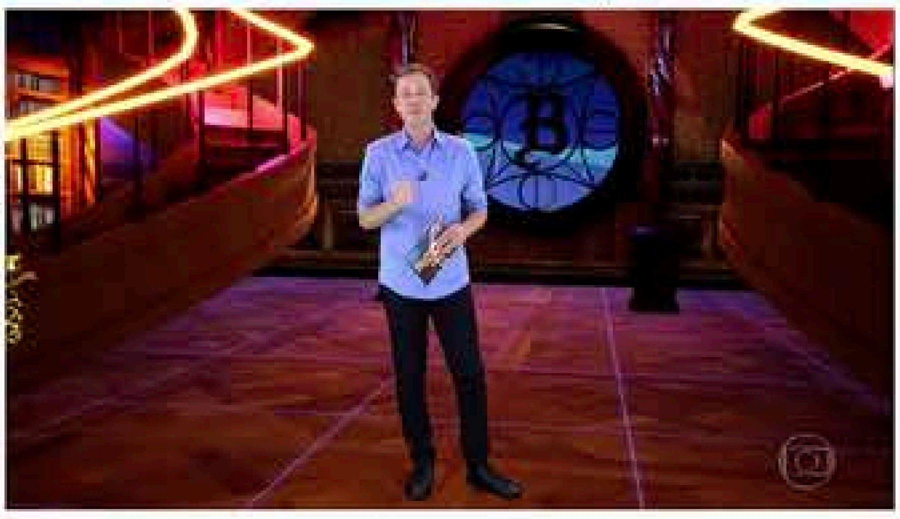
Cenário virtual utilizando chroma key para o Big Brother Brasil 19 com Unreal Engine e Reality Engine

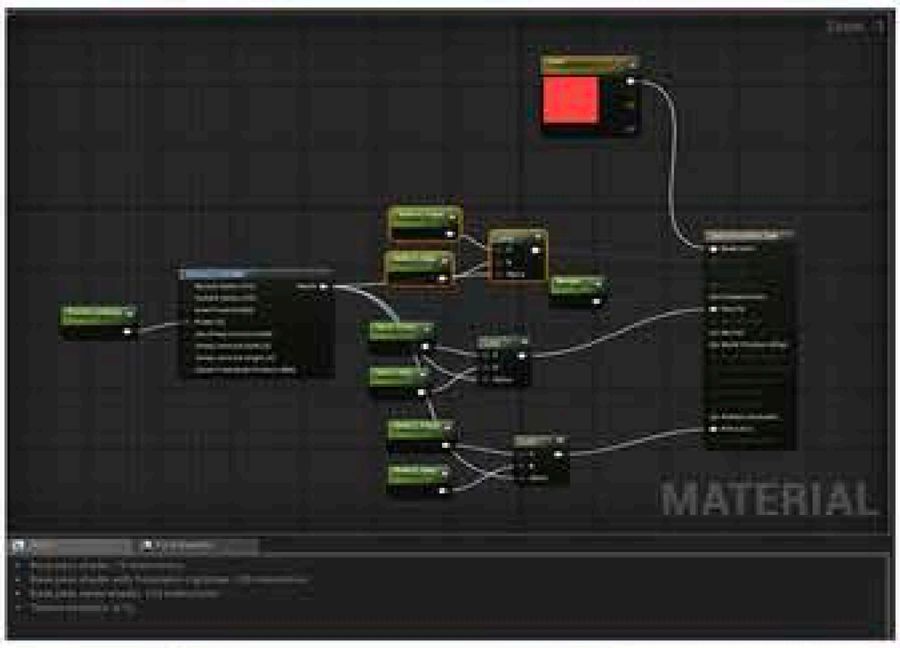
Rodrigo Cipriano, Marcio Fontes, Leonardo Leal, Pablo Bioni, Albino Ribeiro Neto, Paulo Henrique Faria de Araújo Lima, Omar Muro, David Toledo, Teo Tavares, Victor Portella, Fernando Ribeiro, et al, 2019.

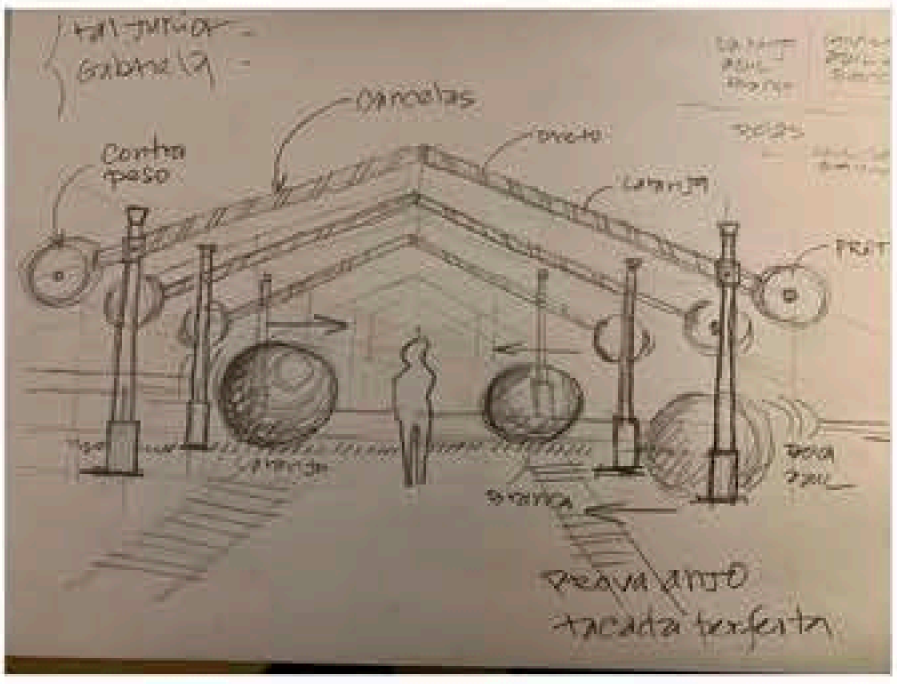
Este trabalho foi realizado utilizando-se a técnica do chroma key, onde coloca-se uma imagem sobre outra através do anulamento de uma cor sólida pré-definida. Este tipo de tecnologia foi utilizado no projeto de cenário virtual para a Rede Globo de televisão no Reality Show Big Brother Brasil 19 - BBB 19, utilizando tecnologia em tempo real, o Virtual Reality Spaces. Através desse sistema foi possível eliminar etapas de pós-produção e cenários físicos. Foram utilizados também elementos de Realidade Aumentada sobrepostos ao apresentador do programa BBB 19, o sistema da Zero Density reconhece os reflexos e sombras do apresentador e as insere no cenário virtual tornando a imersão extremamente convincente. O sistema Reality da Zero Density permitiu também a utilização de trackers de reconhecimento de elementos físicos no cenário virtual e do apresentador em tempo real. O software Unreal Engine foi utlizado para realizar a inserção dos cenários virtuais tridimensionais e as transições destes.

Mais informações em:









Computational Design for the Next Manufacturing Revolution

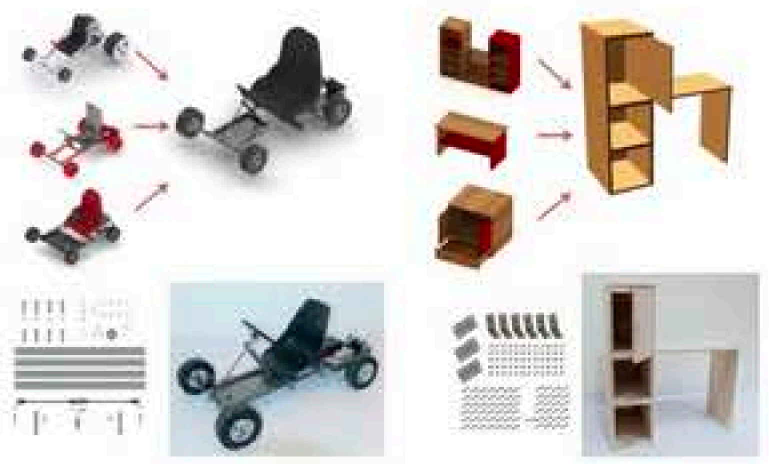
Adriana Schulz

Visgraf 30 ANOS

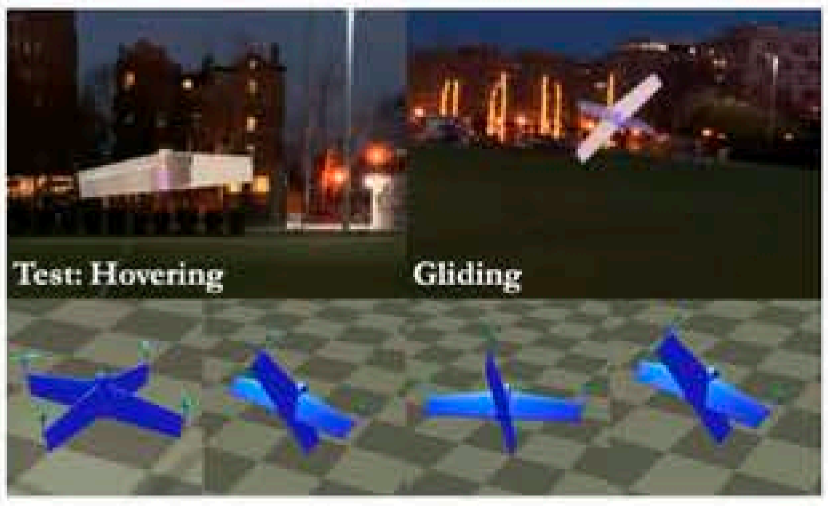
impa

After getting my Masters at VISGRAF advised by Professor Luiz Velho, I went on to get a Ph.D. at MIT and am now an assistant professor of Computer Science at the University of Washington.

My research group focuses on computational design for manufacturing. As 3D printers and industrial robots begin to reshape manufacturing, our goal is to define design tools that will drive and democratize this new industrial revolution.



We use data-driven methods to create intelligent tools that make design more efficient and accessible, and real-time performance-driven methods for design based on functionality. We incorporate these ideas into interactive tools that allow design of complex functional mechanisms that require design and optimization of not only geometry, but also motion and control.



Open Cultural Heritage: The Modern Rio

Asla Medeiros e Sa, Adolfo Ibanez Villa, Karina Rodriguez Echavarria, Ricardo Marroquim, Vivian Luiz Fonseca. 2018

We proposed a methodology for documenting **open** and **medium-large scale** cultural heritage assets. We take advantage of the maturity of 3D digital technologies for enabling communities across the world to support the documentation of Cultural Heritage (CH) assets that are accessible to the public. For the present project, we focus on producing digital replicas of public sculptures from the Modern period situated in public spaces in Rio de Janeiro.

We adopt an open-source pipeline, based on photogrammetry, which is implemented in separate phases: identification, data acquisition, processing, evaluation, and access. These phases present various challenges, including the ones posed by the variety of spaces in which the assets are located in which it is difficult to control the digitisation conditions. The evaluation and access of the resulting documentation is a key component of such projects. We suggest that community-led approaches have the potential to generate digital resources that are relevant both for professionals and the general public. We discuss various options for access, such as web-based solutions, Augmented Reality (AR) applications, as well as 3D printed digital replicas.

Normal Transformations for Overhang Reduction

Carlos de Castro and Leonardo Sacht, 2019

3D printing is a revolutionary method for bringing ideals to the world more easily. The 3D printing process is gaining space in many areas around the world. Its versatility can be used to print artistic objects, architectural mock ups, civil constructions, aerospace models, parts of physics experiments, educational instruments, as well as delicate objects as prosthesis and real representations of human organs. When we need to print some solid in a 3D printer, some parts of this solid, called overhangs, may be suspended in the air and need a support for a better print.

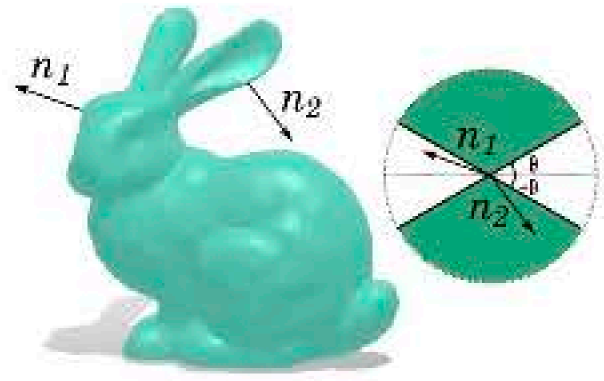


Fig. 1 - These two normals n_1 and n_2 of the Bunny surface have different angles. The normal vector n_1 is within the angle range of the printer. The normal vector n_2 is on an overhanging part and needs support to print correctly.

To deal with overhangs, 3D printers print columns to support the part of this solid that have no material underneath them. This extra material must be removed, leading to a waste of material, time and money.

However, some overhangs are tolerable. Each printer comes with a standard limiting angle to tolerate these overhangs. As we can see in Fig. 1, given a limit angle, the printer only prints an overhang support if the part of the solid that will be printed forms an angle with the horizontal plane less than this limit.

We propose a formulation for the overhang problem based on the normal field of a surface and an optimization to find a global rotation that minimizes overhanging parts that cannot be printed without supports. Fig. 2 illustrates a surface at its starting position and its position after rotation. This global rotation does not change the surface since the printed object can be derotated in the real world after printing.

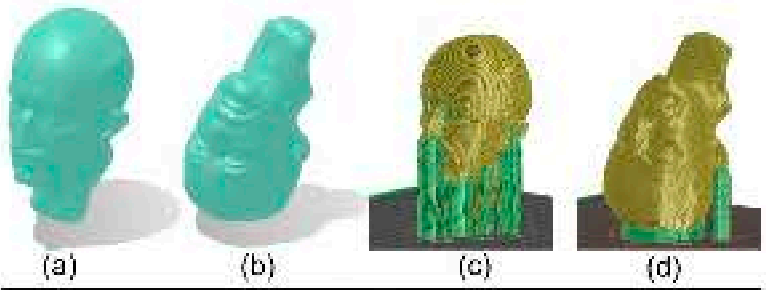


Fig. 2 - Face.obj on the initial vertex position (a) and after rotation (b). The same surface at the initial position on the print simulator (c) and after rotation (d). In yellow, the software indicates the solid that we want to print and in green the overhang supports. The bottom figure is a photo of the same surface after printed. On the bottom-left, the surface is at the initial vertex position and on the bottom-right, the surface is positioned after application of optimal rotation.

More information on:

Visgraf nas redes sociais

Visgraf 30 anos

Seminários de Computação Gráfica

/visgraflab @visgraflab @visgraflab

impa

Visgraf nas redes sociais

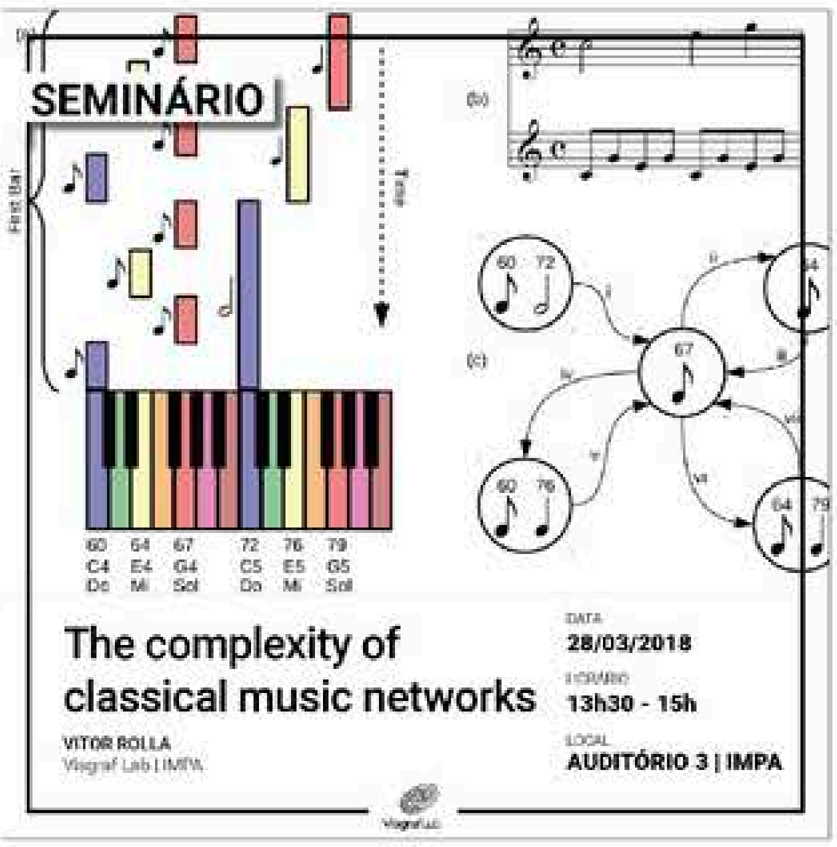
Visgraf 30 anos

Seminários de Computação Gráfica

Visgraf nas redes sociais

Visgraf 30 anos

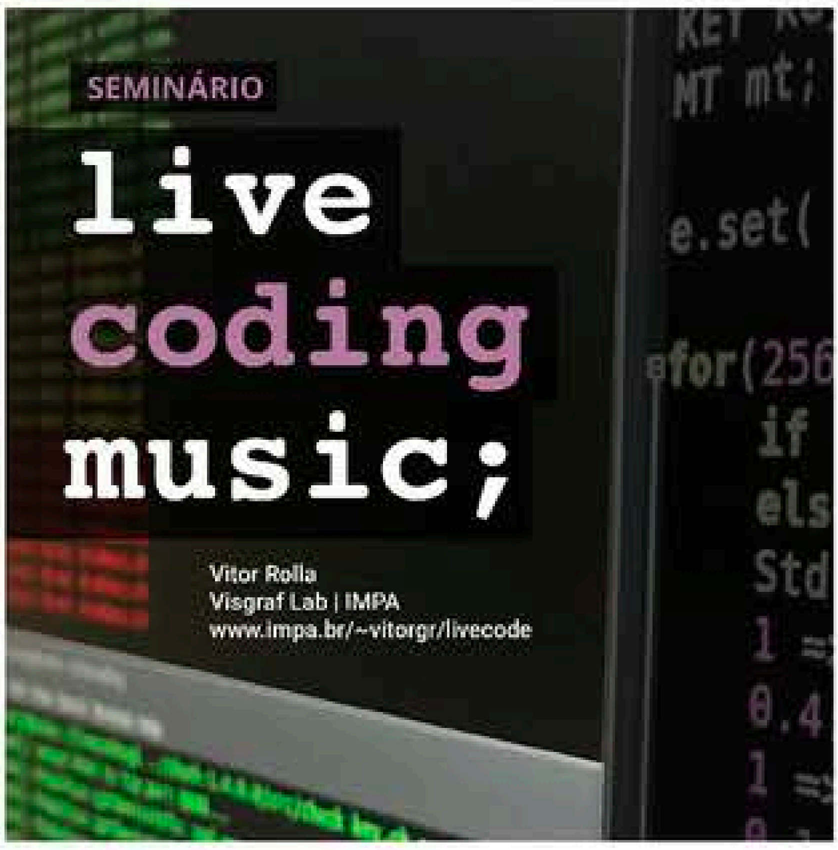
Seminários de Computação Gráfica

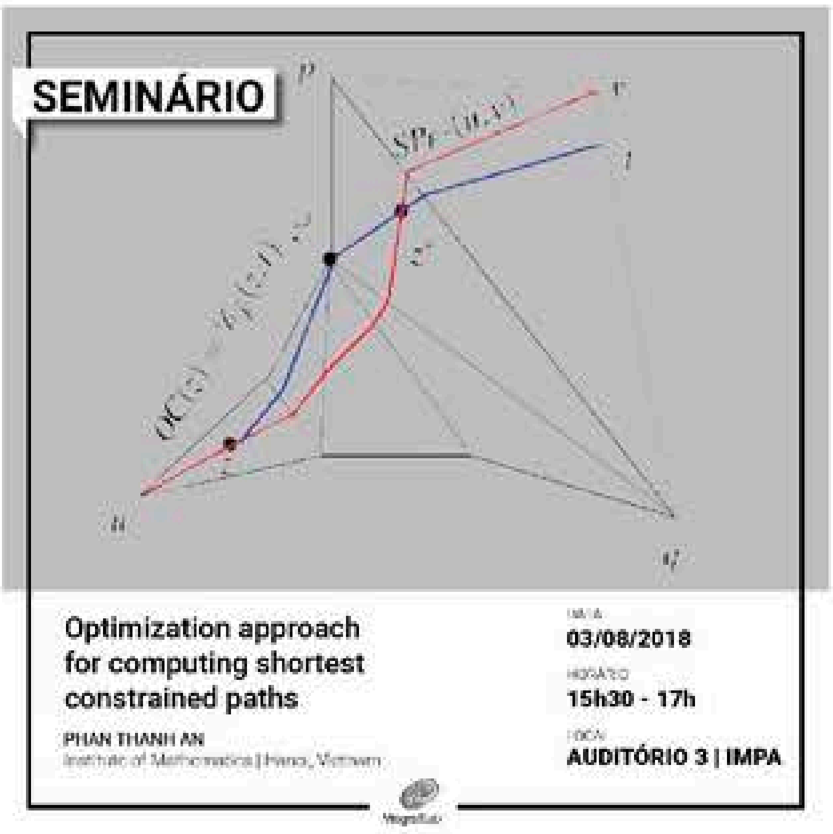


Visgraf nas redes sociais

Visgraf 30 anos

Seminários de Computação Gráfica

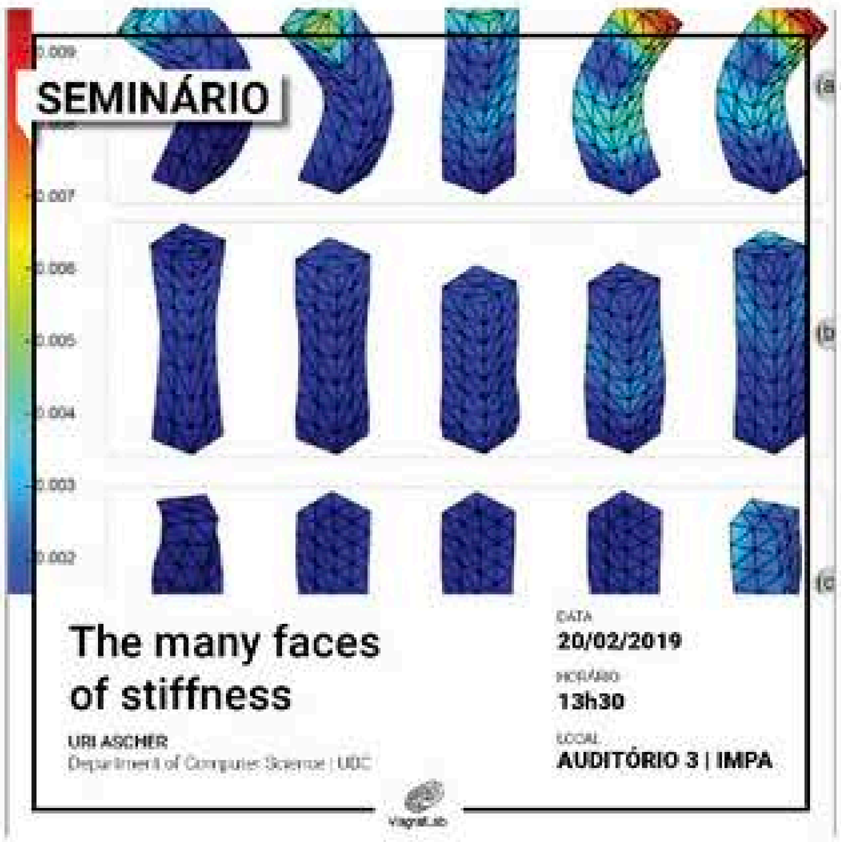




Visgraf nas redes sociais

Visgraf 30 anos

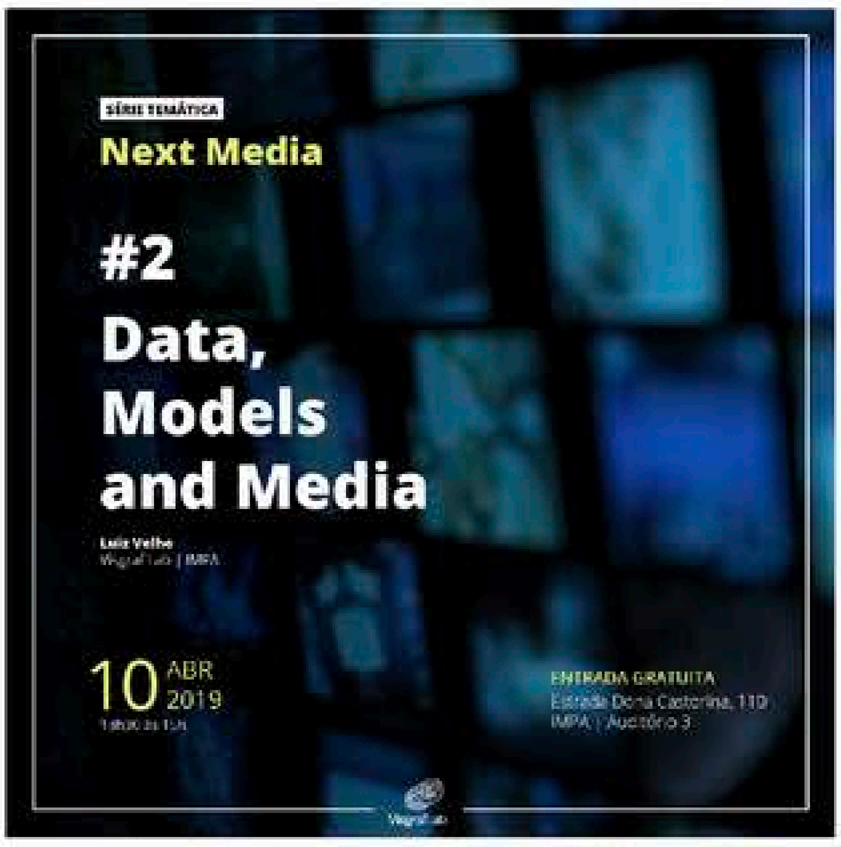
Seminários de Computação Gráfica

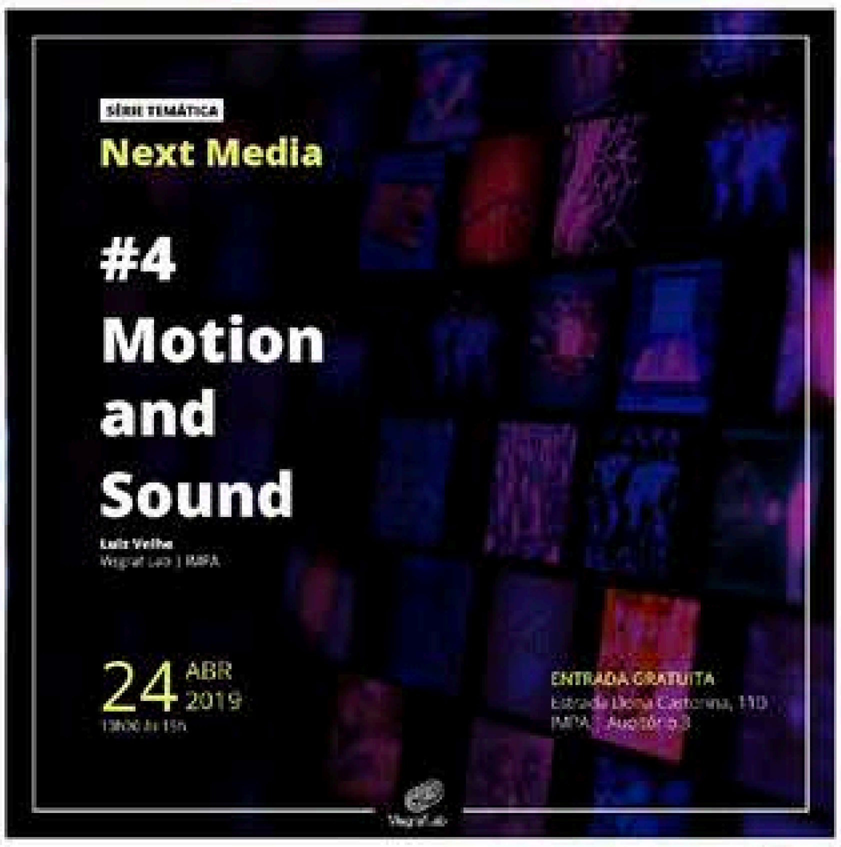


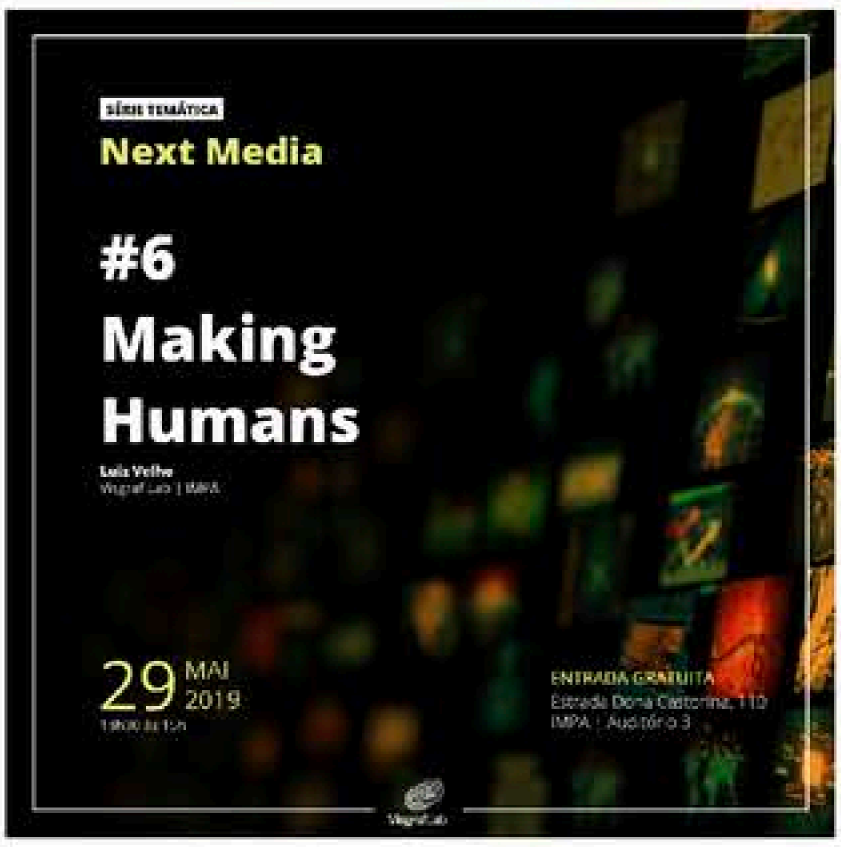
Visgraf nas redes sociais

Visgraf 30 ANOS

Seminários de Computação Gráfica



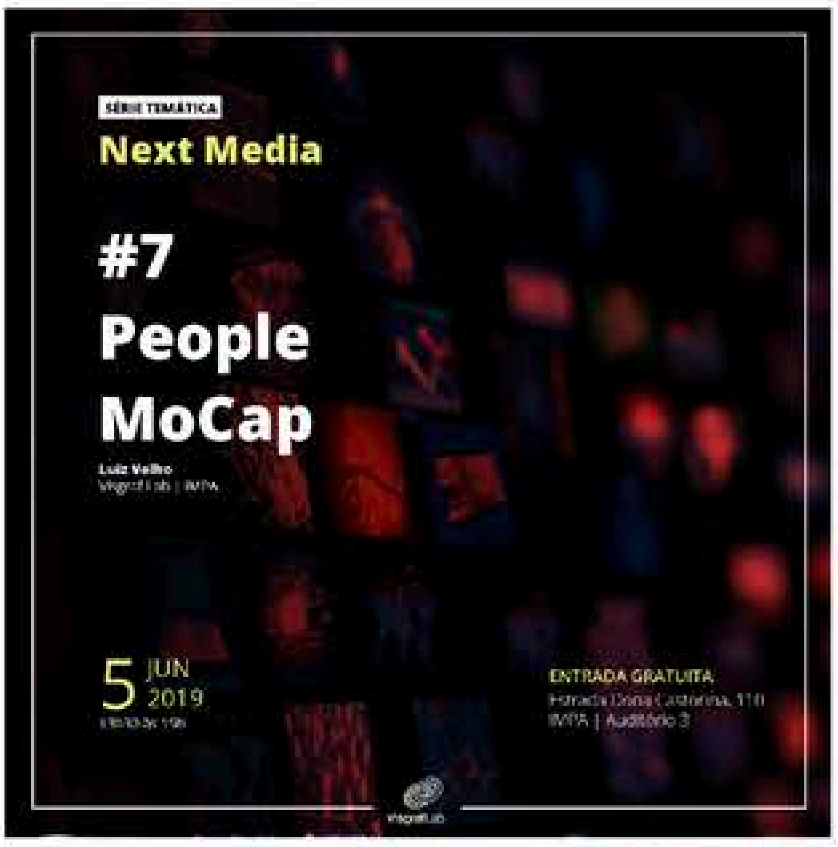


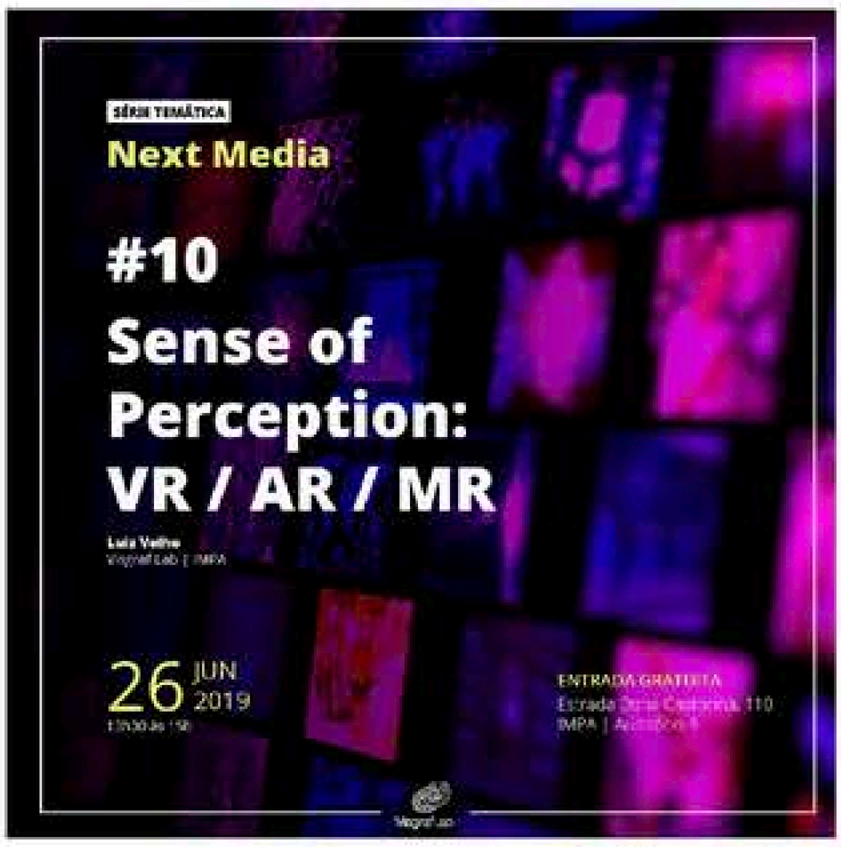


Visgraf nas redes sociais

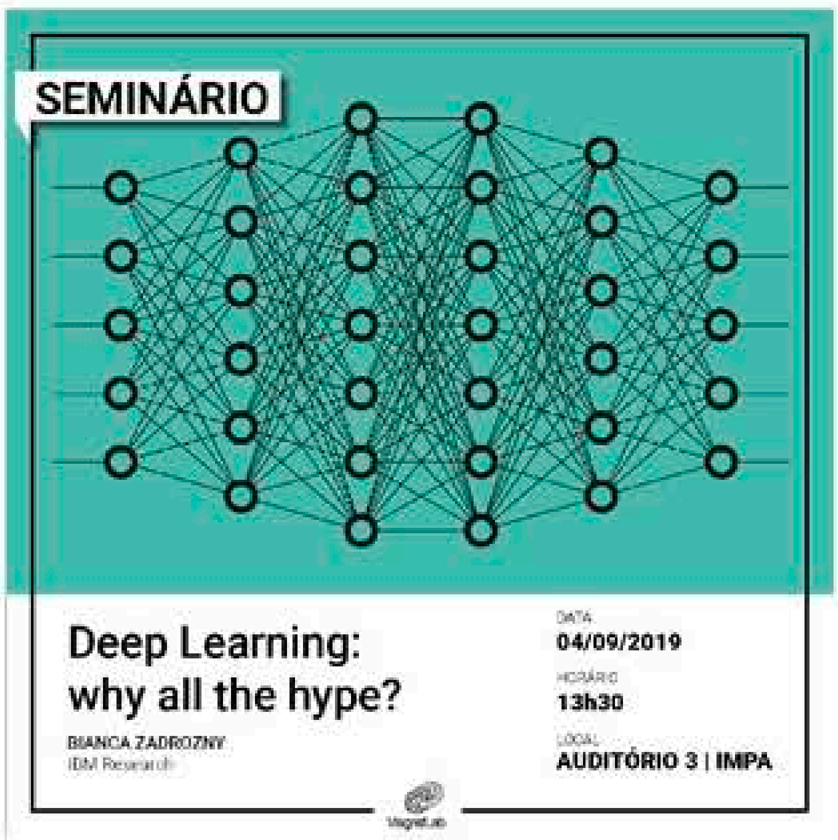
Visgraf 30 ANOS

Seminários de Computação Gráfica





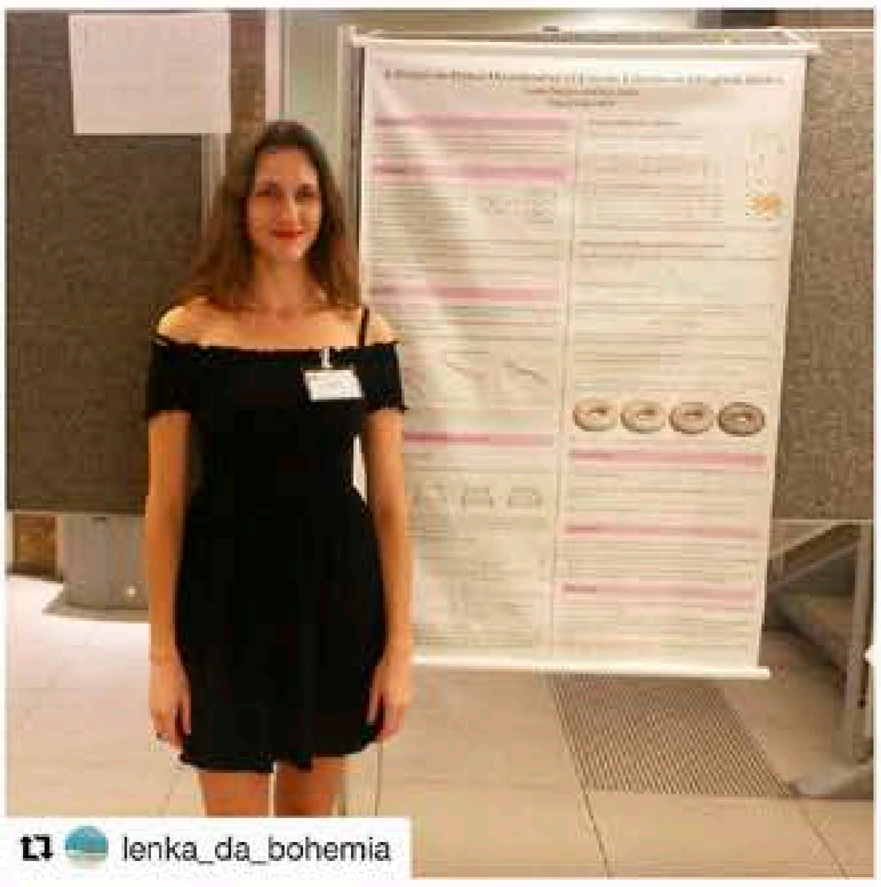
Seminários de Computação Gráfica



Apresentação em conferências

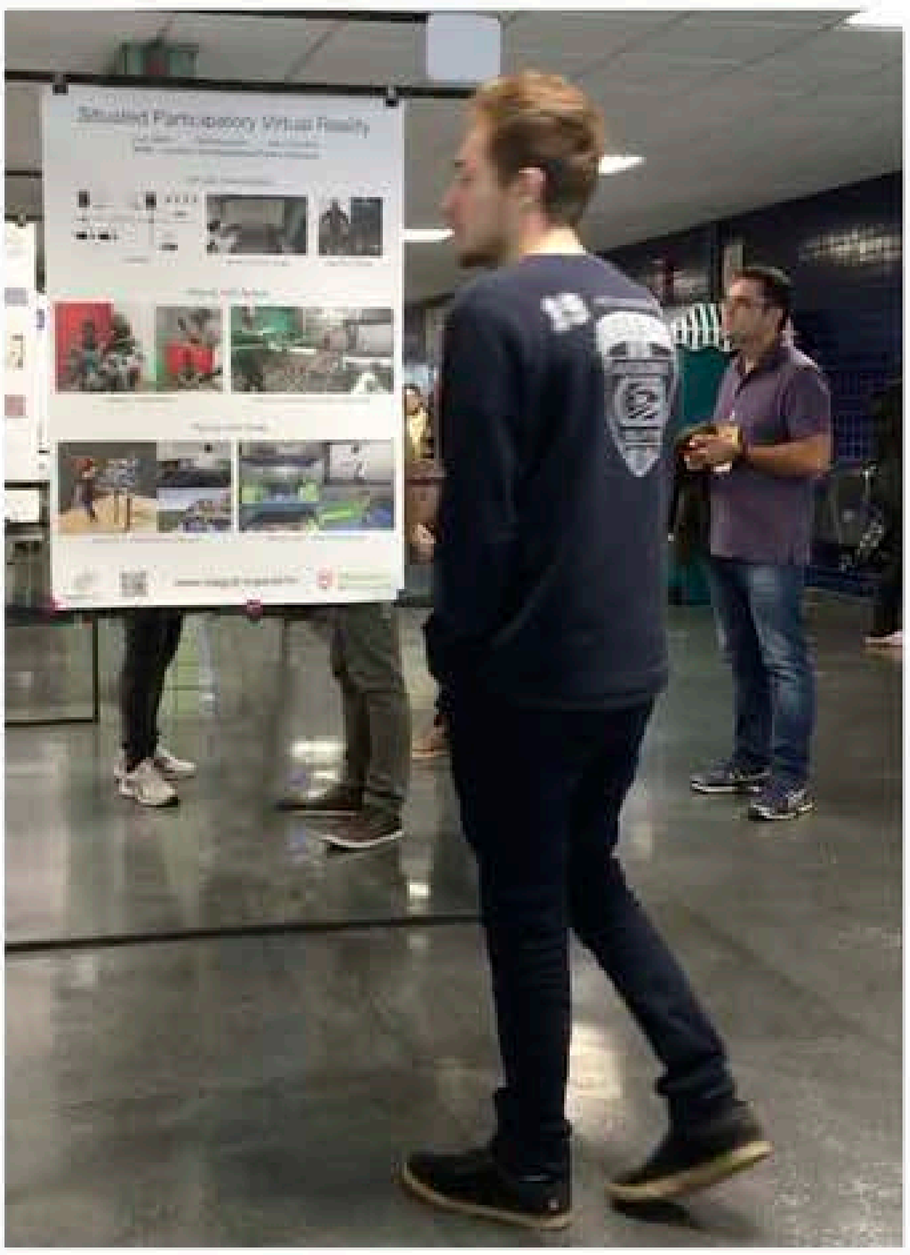
Apresentação em conferências

Apresentação em conferências

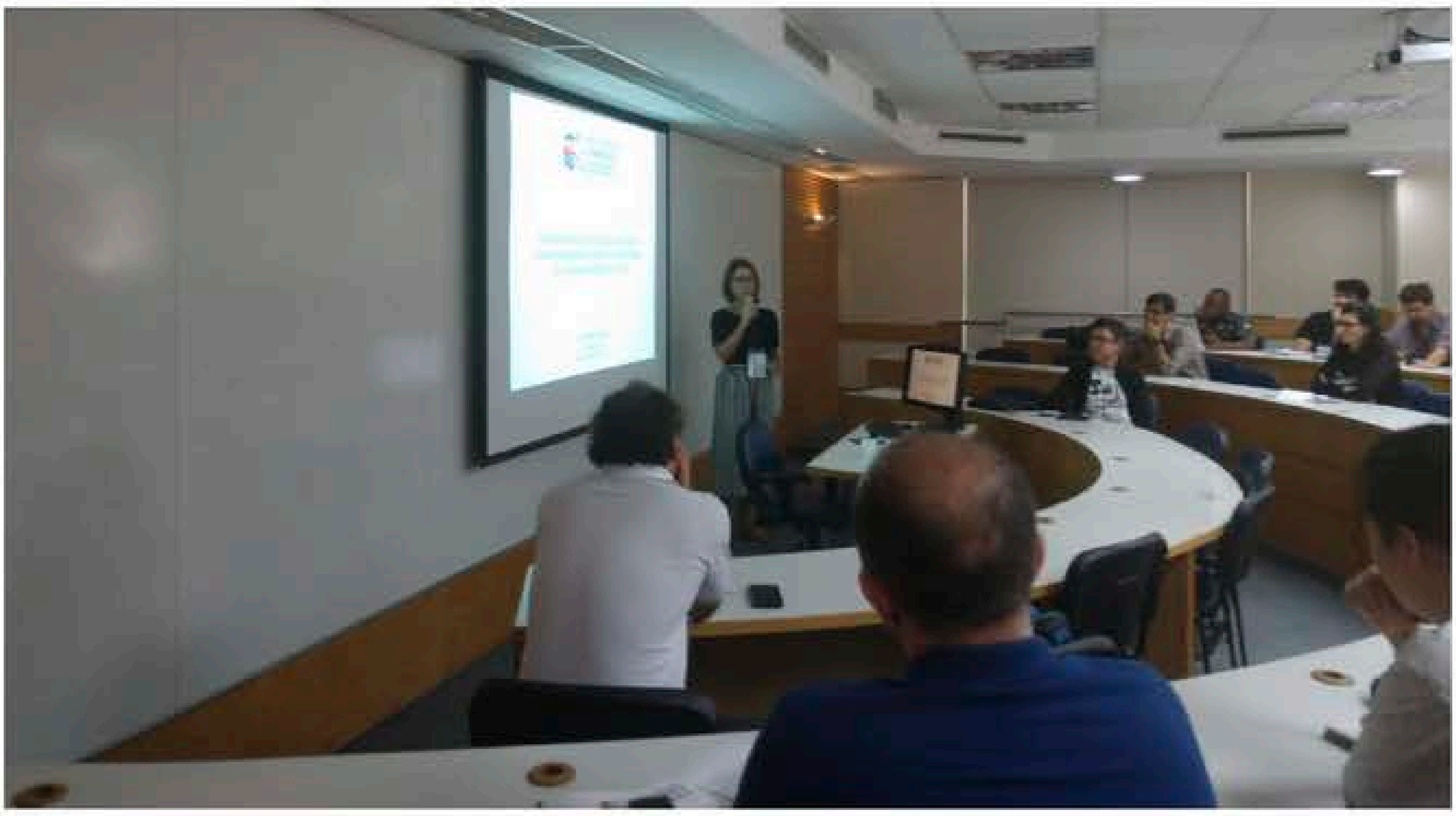


Apresentação em conferências

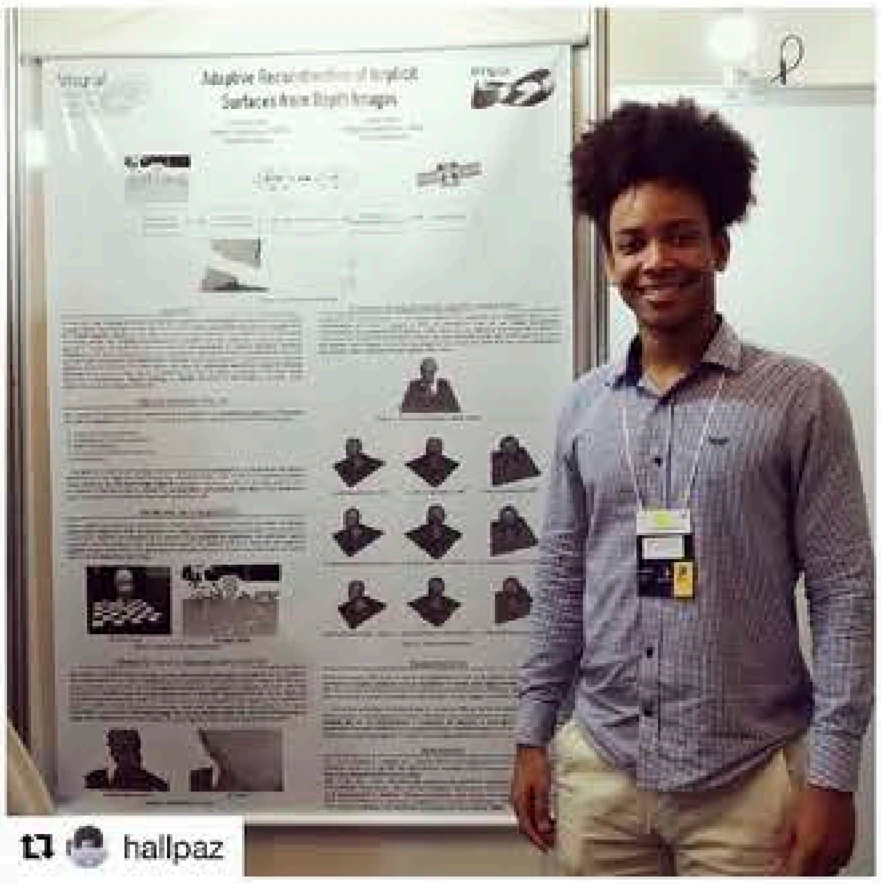
Apresentação em conferências



Apresentação em conferências

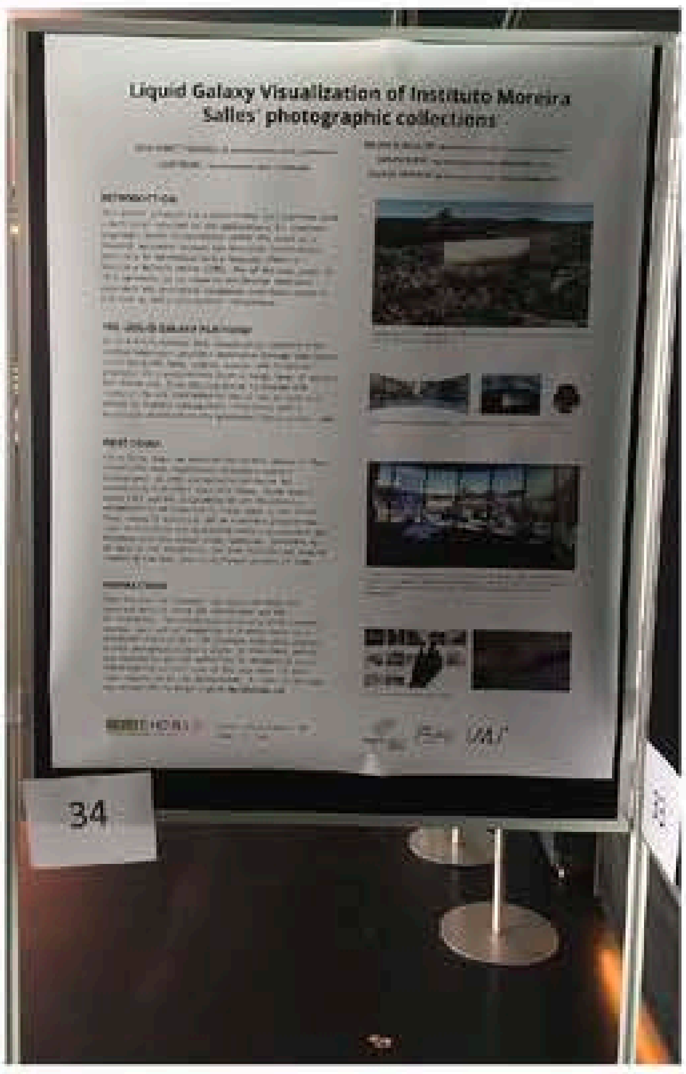


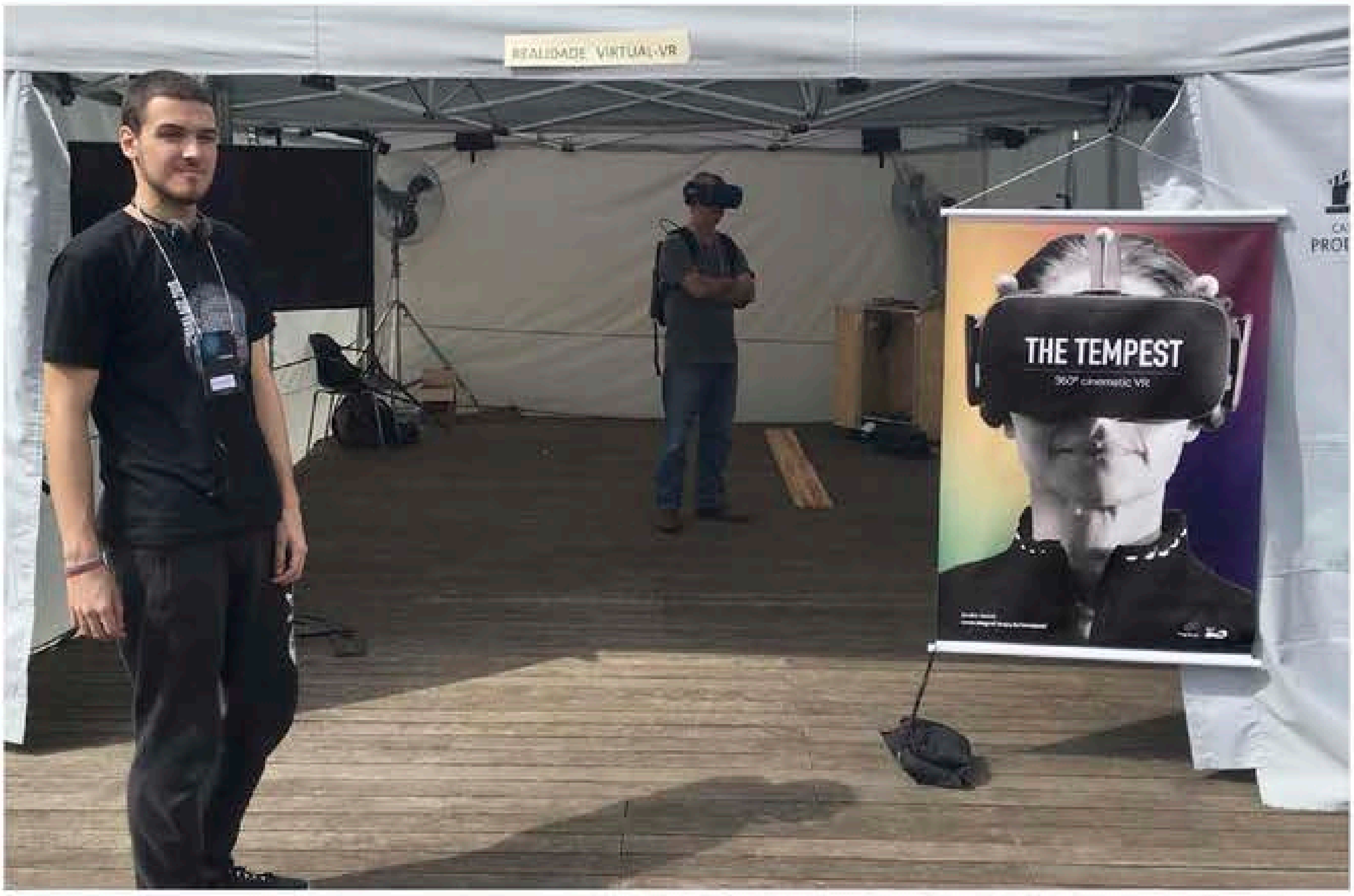
Apresentação em conferências



Apresentação em conferências

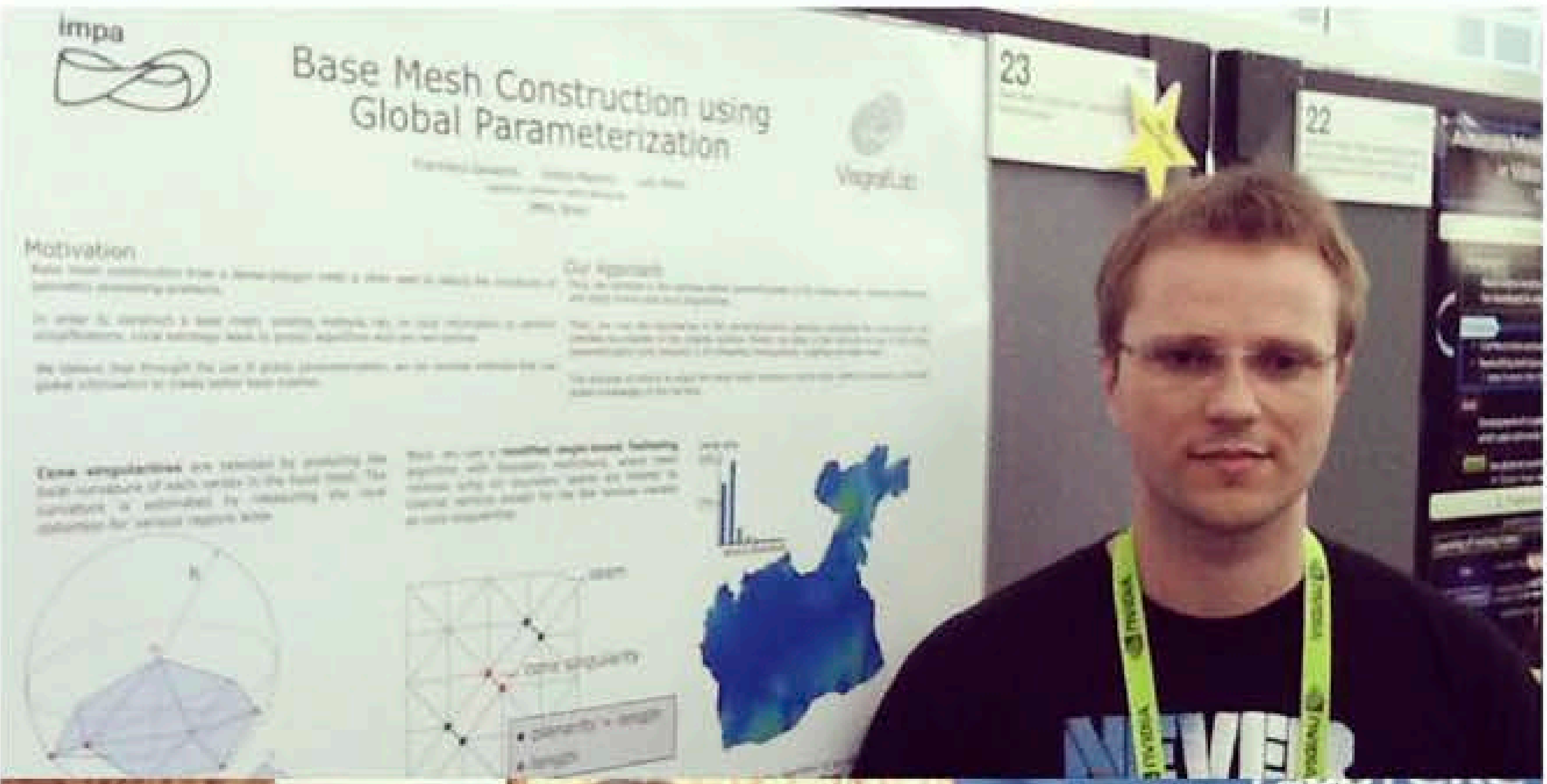
Apresentação em conferências





Apresentação em conferências

Apresentação em conferências

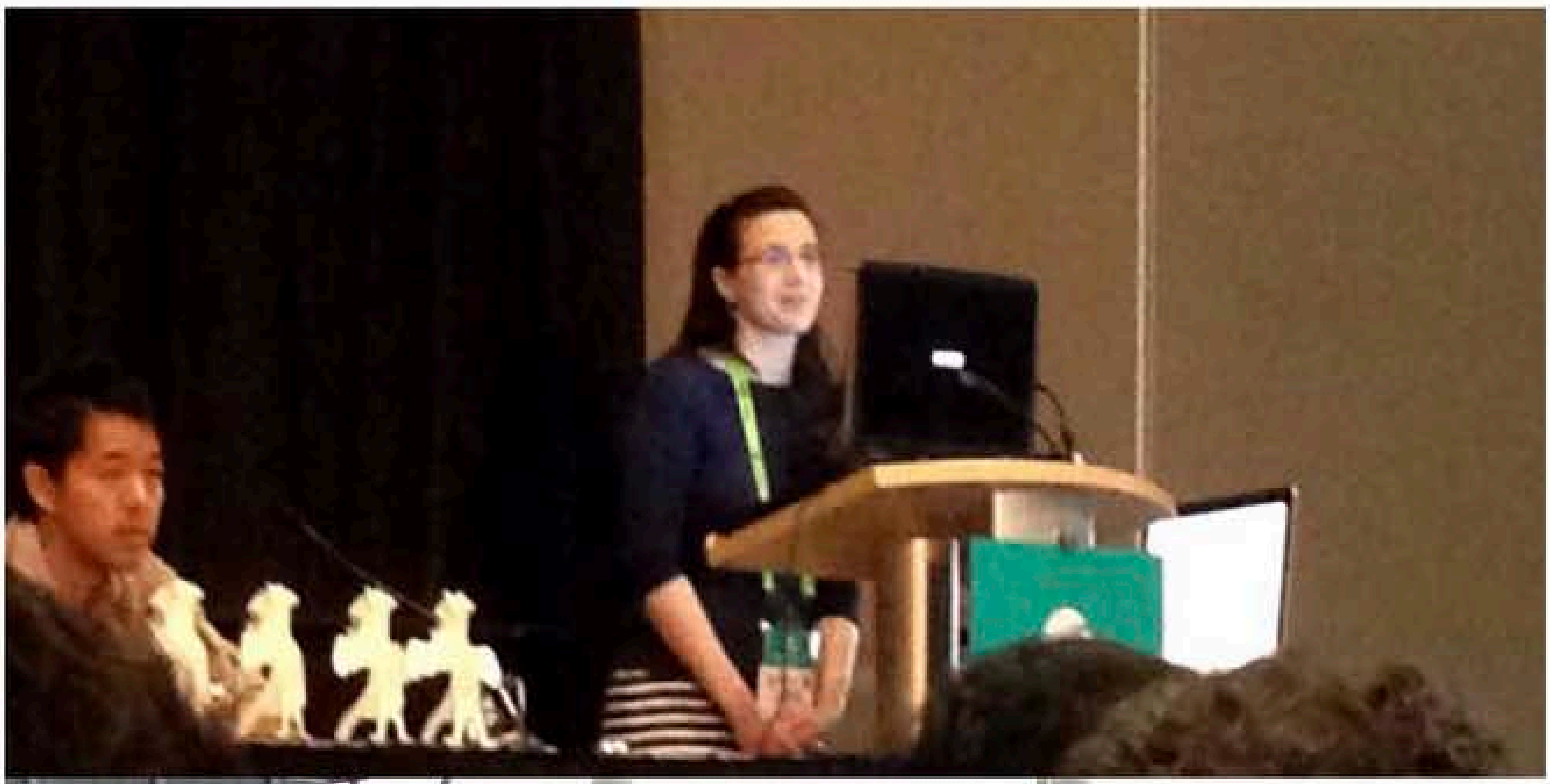


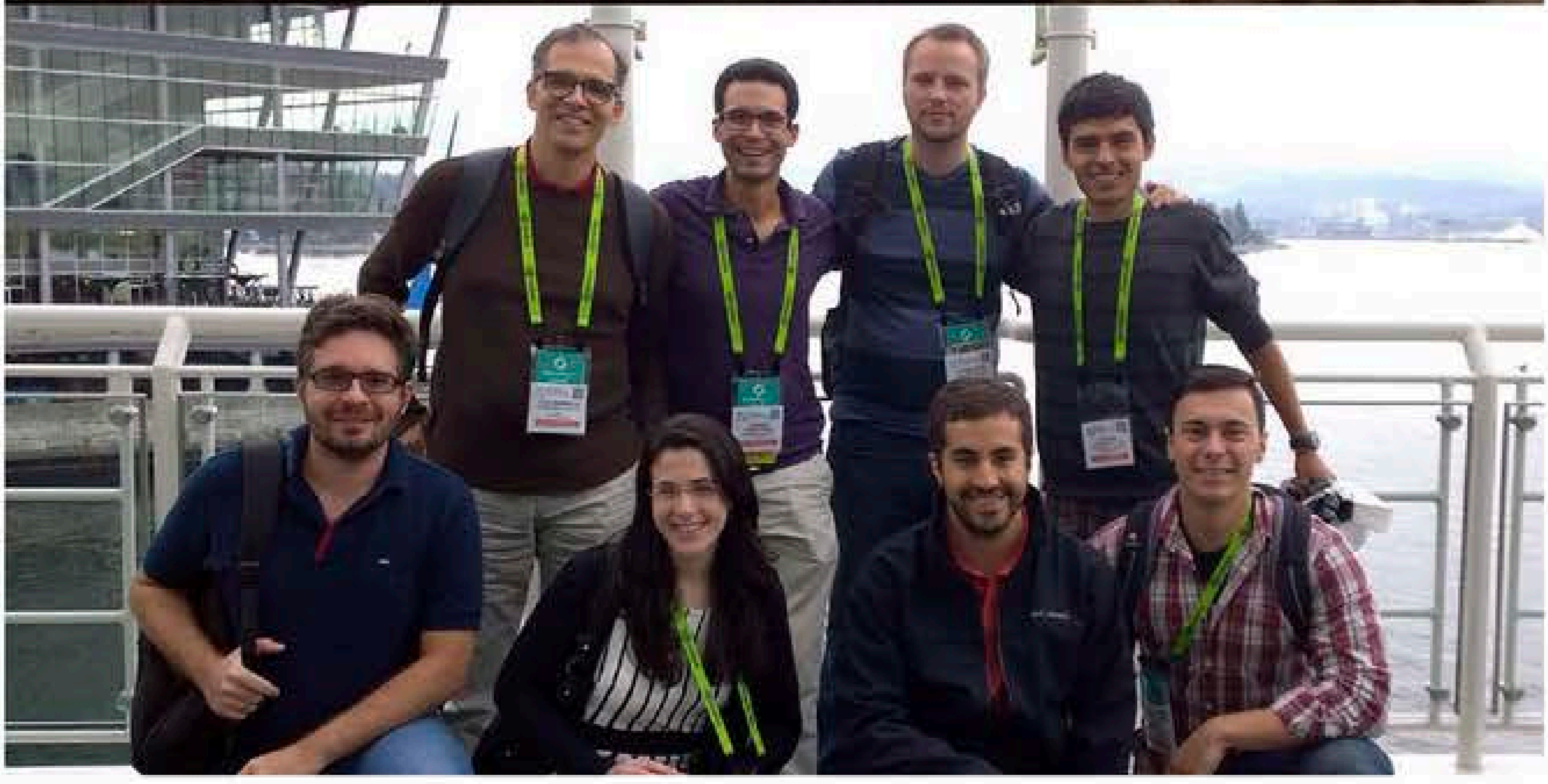
Apresentação em conferências

Apresentação em conferências

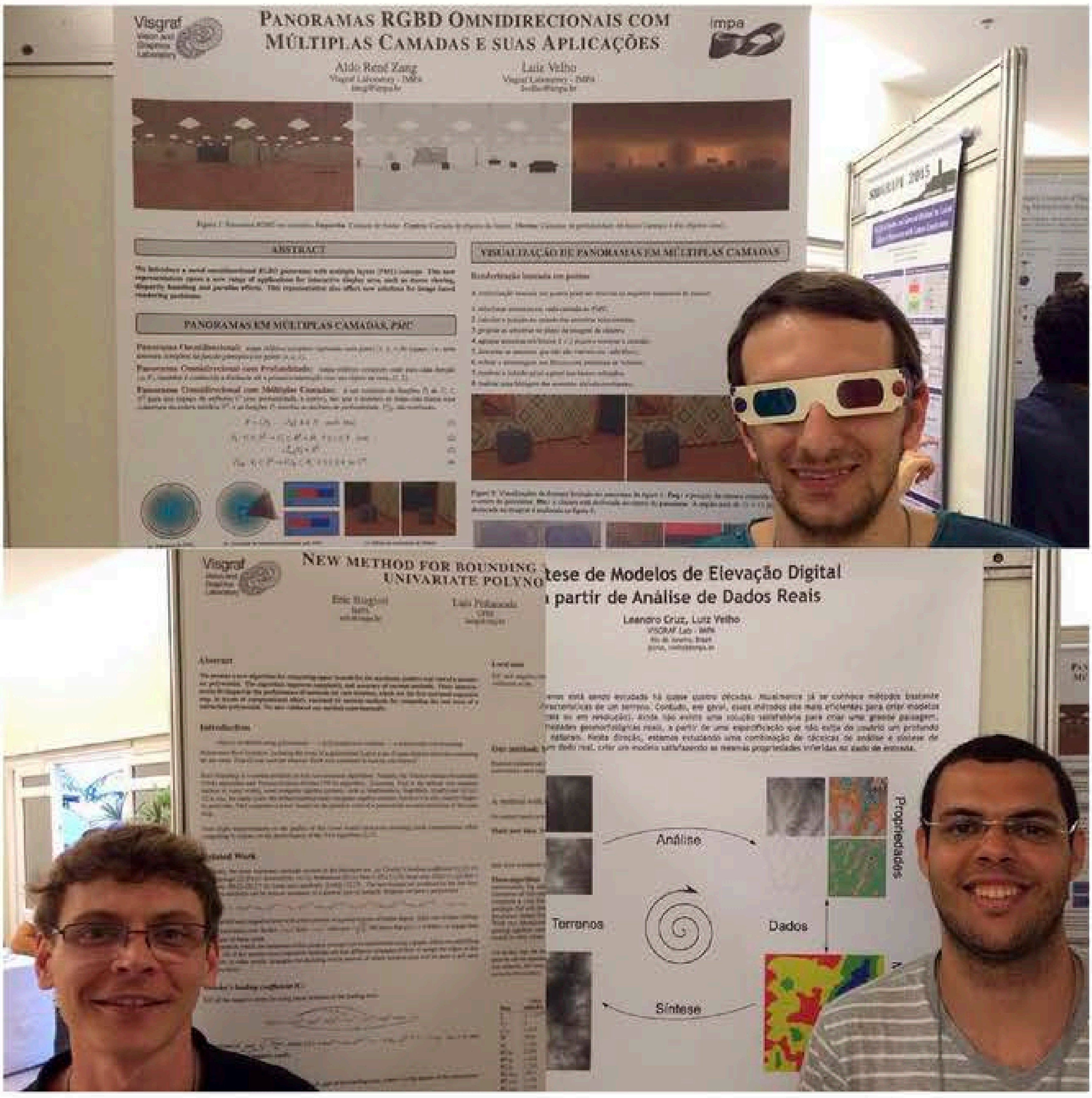
Apresentação em conferências

Apresentação em conferências





Apresentação em conferências



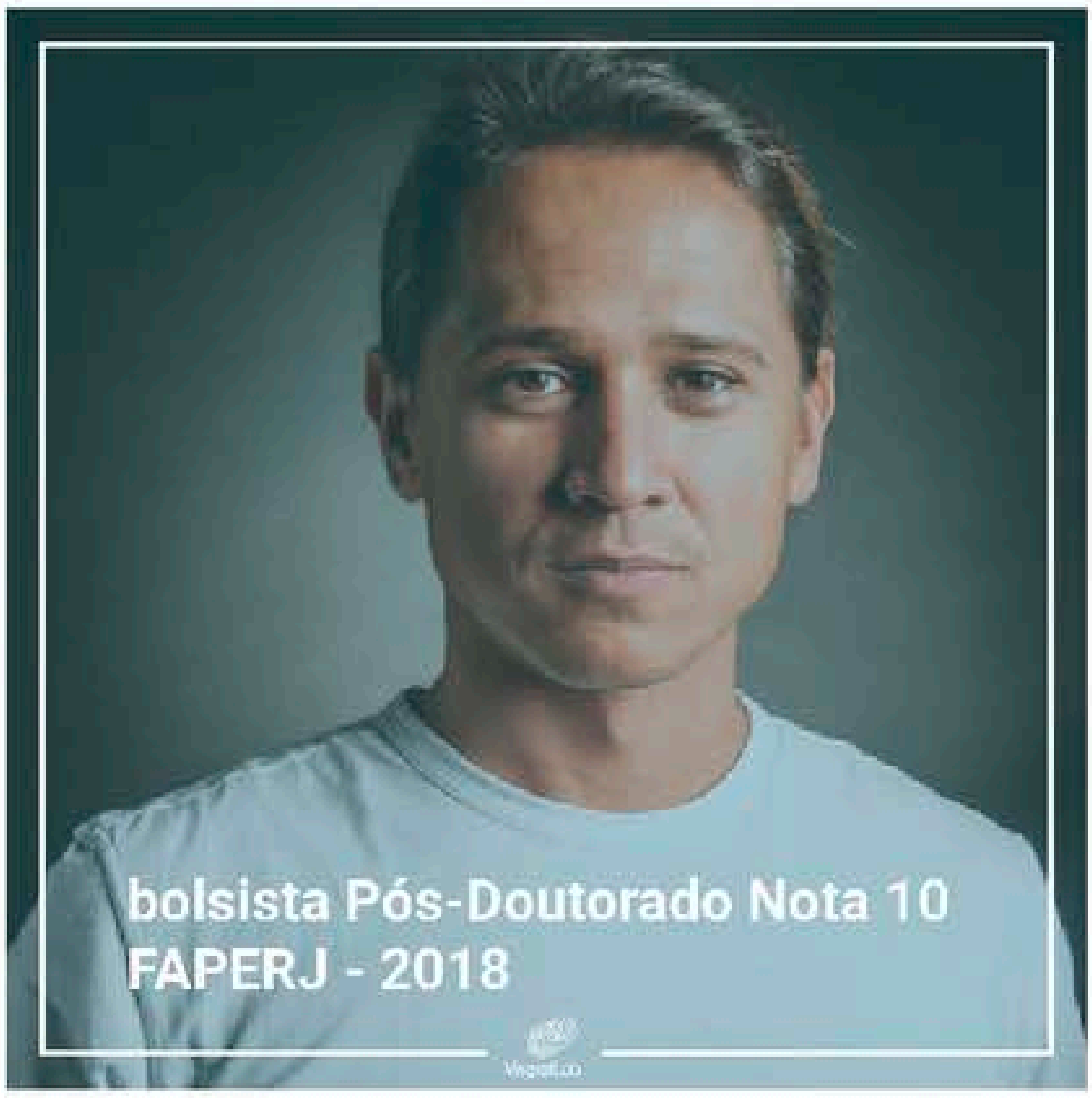
Apresentação em conferências

Momentos

Momentos

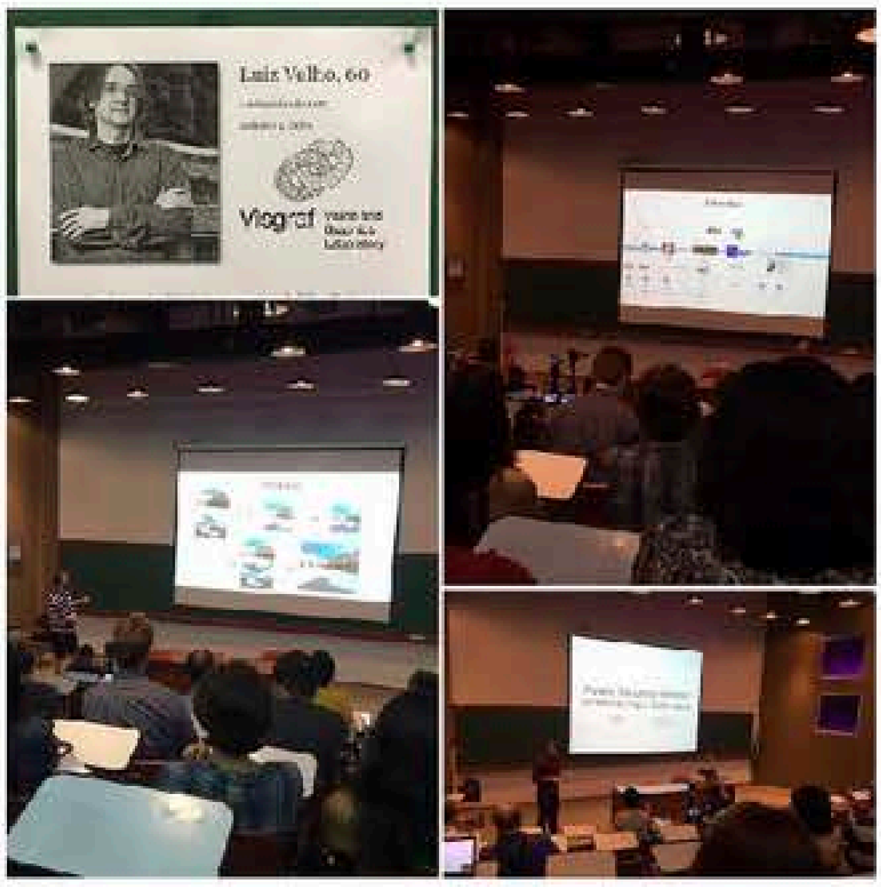

Tese premiada em
Ciências da Computação
MIT EECS - 2018
VisgrafLab


impa
hallpaz


bolsista Pós-Doutorado Nota 10
FAPERJ - 2018
VisgrafLab

Momentos


EVENTO COMEMORATIVO
Luiz Velho | 60 anos
Visgraf

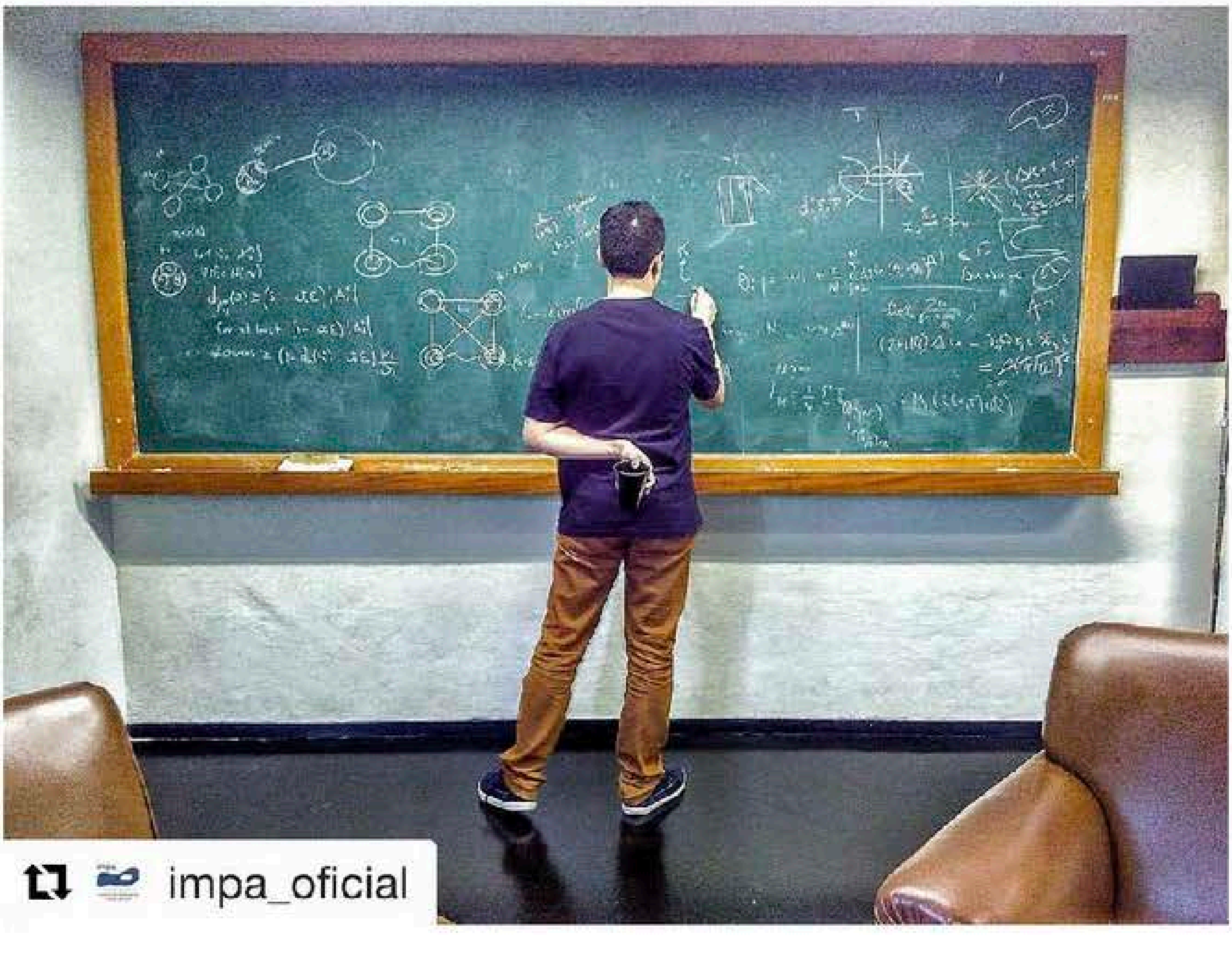

Luiz Velho, 60
Visgraf

Momentos

Momentos

Festival da MATEMÁTICA
RIO DE JANEIRO > 2017

Momentos

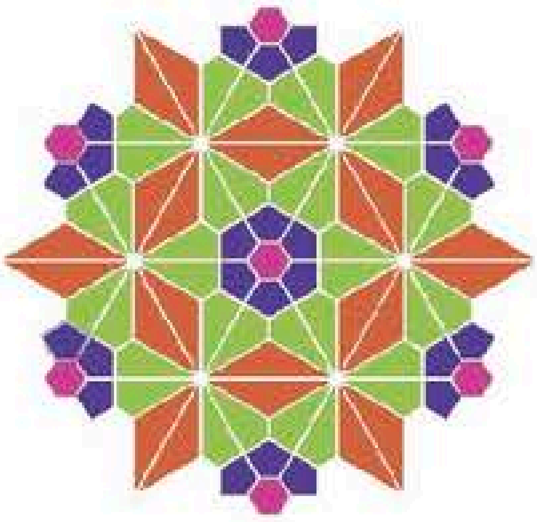


Momentos

Momentos

Momentos


EVENTO
SOBRE
MALHAS
ARQUIMEDIANAS
Sobre malhas Arquimedianas:
ciclo de palestras e
lançamento do livro
RICARDO SÁ, ASLA MEDEIROS E SÁ,
LUIZ VELHO, LUIZ H. FIGUEIREDO e EZEQUIEL SOTO
DATA
29/01/2018
HORÁRIO
16h - 19h
LOCAL
AUDITÓRIO 3 | IMPA
VisgrafLab



Momentos

Visgraf nas redes sociais

Momentos

Momentos


Aventuras de Lilith & Wood
15 de agosto, às 18h30
Entrada gratuita, sujeita à lotação
Estrada Dona Castorina, 110
IMPA | Auditório 3
Direção criativa e encenação
CEGONHA
Pesquisa e desenvolvimento
Visgraf
impa
cegonha_bandodecriacao

Momentos