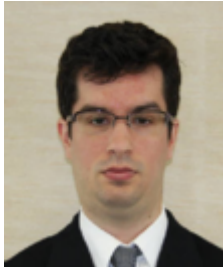


## Computer Graphics Laboratory



Pierre-Alain Fayolle  
Associate Professor



Yohei Nishidate  
Associate Professor

Members of the Computer Graphics Laboratory conduct research into physics-based modeling of different phenomena, visualization and shape modeling. Innovative approaches to graphical user interfaces and direct interaction methods, modeling, rendering, simulation and visualization are under development. Created mathematical models are used for graphical representation of natural and complex phenomena.

Research areas include:

- Visualization of surface and volume data, which results from finite element, boundary element and finite difference modeling.
- Nanomechanics modeling. Finite element and molecular mechanics modeling of micro- and nanostructures.
- Ray-tracing simulation for lens design.
- Augmented reality interface for different fields of human activity.
- Using graphics processing units for physics-based modeling and animation.
- Development of algorithms for shape modeling, analysis and understanding (operations on shape, segmentation and reconstruction).
- Topological data mining/representation for scientific/mathematical visualization.
- Visual representation of texts and networks for information visualization.

## Division of Information and Systems

- Map schematization including 2D railway maps, 3D urban maps, map annotations, aesthetic designs, etc.
- Modeling human visual perception and its application to visual analytics.

Professors of the Computer Graphics Laboratory deliver courses in Computer Graphics, Numerical Analysis, Modeling and Visualization. Graduation projects are related to computer graphics, human-computer interaction, physics-based modeling, shape modeling and processing, visualization, and animation.

## Summary of Achievement

### Refereed Journal Papers

[fayolle-01:2014] Mathieu Sanchez, Oleg Fryazinov, Pierre-Alain Fayolle, and Alexander Pasko. Convolution Filtering of Continuous Signed Distance Fields for Polygonal Meshes. *Computer Graphics Forum*, pages n/a–n/a, 2015.

Signed distance fields obtained from polygonal meshes are commonly used in various applications. However, they can have  $C^1$  discontinuities causing creases to appear when applying operations such as blending or metamorphosis. The focus of this work is to efficiently evaluate the signed distance function and to apply a smoothing filter to it while preserving the shape of the initial mesh. The resulting function is smooth almost everywhere, while preserving the exact shape of the polygonal mesh. Due to its low complexity, the proposed filtering technique remains fast compared to its main alternatives providing  $C^1$ -continuous distance field approximation. Several applications are presented such as blending, metamorphosis and heterogeneous modelling with polygonal meshes.

### Refereed Proceeding Papers

[nisdiate-01:2014] Y. Nishidate. Ray-tracing simulation procedure for general isotropic inhomogeneous refractive-index media. In *The 15th International Conference on Precision Engineering (ICPE2014)*, page D22, Kanazawa, Jul. 2014. JSPE.

A ray-tracing simulation procedure has been developed for isotropic inhomogeneous refractive-index media. In order to achieve ray-tracing in satisfactory precision, a locally quadratic interpolant, the Nagata patch, is applied for reproducing the lens surface, and moving least squares method is used for local reconstruction of arbitrary discrete distribution of refractive-index. For ray-tracing in the inhomogeneous media, the ray equation of geometric optics is integrated with automatic step size adjustment. Also, an iterative procedure is proposed to maintain precision near the exit of inhomogeneous media.

### Academic Activities

[fayolle-02:2014] Pierre-Alain Fayolle, 2014.

## Summary of Achievement

Program committee member, Shape Modeling International 2014

[fayolle-03:2014] Pierre-Alain Fayolle, 2014.

Reviewer, Journal of Visual Languages and Computing

[fayolle-04:2014] Pierre-Alain Fayolle, 2014.

Reviewer, SIGGRAPH 2014

[fayolle-05:2014] Pierre-Alain Fayolle, 2014.

Reviewer, Pacific Graphics 2014

[nishidate-02:2014] Y. Nishidate, Feb. 2015.

Reviewer, Applied Optics

### **Ph.D and Others Theses**

[nishidate-03:2014] Junta Muramatsu. Graduation thesis, University of Aizu, 2014.

Thesis Advisor: Y. Nishidate

[nishidate-04:2014] Takeru Hirano. Graduation thesis, University of Aizu, 2014.

Thesis Advisor: Y. Nishidate

[nishidate-05:2014] Shuichiro Murata. Graduation thesis, University of Aizu, 2014.

Thesis Advisor: Y. Nishidate