Programme de la journée du département 1
Algorithmique, calcul, image et géométrie
31 mai 2016

9h30	Jean Hergel (Alice)	3D Fabrication of 2D Mechanisms
	Antoine Fond (Magrit)	Indices contextuels et description structurelle pour la détection de façades
	Iordan Iordanov (Vegas)	Triangulations of hyperbolic manifolds
10h30	Pause	
11h	Jeremie Dumas (Alice)	Structure and Appearance Optimization for Controllable Shape Design
	Svyatoslav Covanov (Caramba)	Optimal formulae for short product and matrix product
	Khadija Musayeva (ABC)	Guaranteed risks for multi-category margin classifiers
12h	Déjeuner	
13h30	Jaime Garcia-Guevara (Magrit)	Stereo endoscope calibration and 3D US vessel detection for Augmented Reality Hepatic Surgery
	Simon Abelard (Caramba)	Comptage de points de courbes hyperelliptiques
	Maxence Reberol (Alice)	Finite element method, hybrid hexahedral-tetrahedral meshes and distances
14h30	Fin	

Jean Hergel (Alice): 3D Fabrication of 2D Mechanisms

The success off physical sandbox applications shows that users enjoy designing mechanisms. In these applications user design 2D shape without worrying about the geometric details that would be necessary to produce a real mechanism. We propose to start from such casual designs of mechanisms and turn them into a 3D model that can be printed onto filament based 3D printers. The input 2D mechanism allows for some parts to overlap during simulation. These overlapping parts have to be resolved into non–intersecting 3D parts in the real mechanism. The 3D shape of the parts is inferred from the 2D input and the simulation of the mechanism.

Antoine Fond (Magrit) : Indices contextuels et description structurelle pour la détection de façades

Nous nous intéressons ici à la détection de façades dans le but d'améliorer la mise en correspondance image/modèle de bâtiments pour le calcul de pose en milieux urbain. Après une étape de rectification automatique, nous employons un schéma en deux étapes. Premièrement une cascade de classifieurs LogitBoost basés sur des indices simples faisant intervenir le contexte local sélectionne quelques fenêtres parmi un ensemble de fenêtres tirées selon une distribution a priori. Ces façades potentielles sont ensuite décrites plus structurellement par leur représentation de Haar-Fourier. Elles sont finalement retenues ou écartées par un classifieur fort SVM. Les résultats sont évalués sur une base de test de 410 images urbaines.

Iordan Iordanov (Vegas): Triangulations of hyperbolic manifolds

Delaunay triangulations and their dual Voronoi diagrams are among the most important structures in Computational Geometry. They are well-studied and many algorithms to efficiently compute them exist, but these results are mainly confined to the Euclidean d-dimensional space. Previous work has dealt with computing Delaunay triangulations on closed flat manifolds, i.e., compact quotient spaces of the Euclidean space by a discrete group of isometries. An implementation for the special case of the 3D flat torus exists in CGAL. Our work is a study of the case of the double torus, which is a hyperbolic surface, i.e. a quotient space of H2 by a group of hyperbolic isometries. We aim at the mathematical and practical analysis of such triangulations, at the implementation of efficient algorithms for their

construction, long-term integration into CGAL, and also eventual generalizations to higher dimensions or genus.

Jeremie Dumas (Alice): Structure and Appearance Optimization for Controllable Shape Design

We present a new optimization scheme for controllable shape design. A structure emerges from a given loading scenario, and resemble an input exemplar while enforcing mechanical constraints. This scheme empowers experts and casual users to explore a wide variety of shapes design from simple specifications.

Svyatoslav Covanov (Caramba): Optimal formulae for short product and matrix product

In 2012, Barbulescu, Detrey, Estibals and Zimmermann proposed a new framework for the search of optimal formulae for bilinear maps. This framework allows one to retrieve famous formulae in finite fields like the one proposed by Karatsuba for the multiplication of polynomials of degree two, by an exhaustive search. In this presentation, this framework is developped by taking care of eventual symmetries of bilinear maps and an idea permitting to remove some branches during the exhaustive search is considered, leading to the computation of new formulae for the short product and the matrix product. We are able to prove in particular that there is essentially only one optimal decomposition of the matrix product *(3,2,3)* up to the action of some group of automorphisms.

Khadija Musayeva (ABC): Guaranteed risks for multi-category margin classifiers

One of the main open questions in the theoretical analysis of multi-category pattern classification is the dependency of the generalization performance of classifiers on the number of categories. So far, upper bounds on the generalization performance (guaranteed risks) have mainly been derived for specific families of classifiers, implying that they are ad hoc by nature. Our current work deals with the derivation of guaranteed risks under minimal assumptions regarding both the problem (distribution of the data) and the classifier (measurability conditions). The first topic addressed is the influence of the choice of the empirical pseudo-metric used to characterize the "capacity" of the classes of functions involved. Specifically, we focus on pseudo-metrics associated with the L_p-norms.

Jaime Garcia-Guevara Fond (Magrit): Stereo endoscope calibration and 3D US vessel detection for Augmented Reality Hepatic Surgery

Augmented reality hepatic surgery needs pre and intraoperative data non rigid registration. To achieve the registration bio-mechanical models are created from the (MRI/CT) preoperative data. The models simulate deformation to fit intraoperative anatomical features (liver surface reconstructed from stereo endoscope and vessels segmented from 3D US). The intraoperative vessel features are important to guarantee accurate inner deformation of the model. In the presentation two parts of the intraoperative features extraction are described. First robust endoscopic stereo calibration that is needed because the 3D reconstruction is uncertain when the reconstruction rays angle is small. The second part is 3D US vessel tree centerline detection that includes preprocess filtering and shadow detection to overcome image artifacts.

Simon Abelard (Caramba) : Comptage de points de courbes hyperelliptiques

Si les courbes font partie du paysage de la cryptographie moderne, toutes ne présentent pas le même intérêt en termes d'efficacité et de sécurité. Un des critères essentiels est justement la taille du groupe associé à la courbe, qui doit être suffisamment grande et qu'il faut donc être capable de calculer.

Maxence Reberol (Alice): Finite element method, hybrid hexahedral-tetrahedral meshes and distances

This talks will give insights on how to solve partial differential équations with the finite element method on hybrid non-conforming hexahedral-tetrahedral meshes. Some preliminary results obtained with low-order Lagrange finite elements will be presented. The talk will also discuss a method based on a computer graphics approach to measure distances between scalar field defined on distinct meshes. Such method allows to compare performances of different numerical methods on arbitrary meshes.