INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team EVASION

Virtual environments for animation and image synthesis of natural objects

Grenoble - Rhône-Alpes

THEME COG

Activity Report

2008

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The EVASION project-team, LJK-IMAG laboratory (UMR 5224), is a joint project between CNRS, INRIA, Institut National Polytechnique de Grenoble (Grenoble INP), Université Joseph Fourier (UJF) and Université Pierre-Mendès-France (UPMF).

1. Team

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2. Overall Objectives

2.1. Introduction

The EVASION project addresses the modeling, animation, visualization and rendering of natural scenes and phenomena. In addition to the high impact of this research on audiovisual applications (3D feature films, special effects, video games), the rising demand for efficient visual simulations in areas such as environment and medicine is also addressed. We thus study objects from the animal, mineral and vegetal realms, all being possibly integrated into a complex natural scene. We constantly seek a balance between efficiency and visual realism. This balance depends on the application (e.g., the design of immersive simulators requires real-time, while the synthesis of high-quality images may be the primary goal in other applications).

From its creation, EVASION mostly tackled the modeling, animation, visualization and rendering of isolated natural objects or phenomena. A very challenging long term goal, that may be not reachable within the next few years but towards which we should tend, would be to simulate full, complex natural scenes combining many elements of different nature. This would enable us to test our algorithms on real-size data and to achieve new applications such as the interactive exploration of a complex, heterogeneous data set from simulation, or of a visually credible natural scene. Being able to animate this scene during exploration and to interact with the simulation taking place would be very interesting. The three objectives below set up several milestones towards this long term goal.

2.2. Creation of digital content

Natural scenes present a multitude of similar details, which are never identical and obey specific physical and space repartition laws. Modeling these scenes is thus particularly difficult: it would take years for a designer, and is not easy to do either with a computer. Moreover, interfaces enabling intuitive and fast user control should be provided. Lastly, explicitly storing the information for every detail in a landscape is obviously not possible: procedural models for generating data on the fly, controlled by mid or high-level parameters, thus have to be developed. Our first objective for the next few years is therefore to develop novel methods for specifying a natural scene. This includes modeling the geometry of individual elements, their local appearance, positioning them within a full scene and controlling motion parameters. More precisely, we will investigate:

- New representations and deformation techniques for intuitive shape modeling.

- The exploitation of sketching, annotation and analysis of real-data from video, 3D scanners and other devices for the synthesis and animation of natural scenes.
- The procedural synthesis of geometry, motion and local appearance (texture, shaders) using existing knowledge, user input and/or statistical data.

2.3. Animating nature

Most natural scenes are in motion. However, many of the animated phenomena that we can observe in nature have never been realistically, yet efficiently simulated in Computer Graphics. Our approach for tackling this problem is to increase and deepen our collaborations with scientist from other disciplines. From our past experiences, we believe that such interdisciplinary collaborations are very beneficial for both parties: they provide us with a better understanding of the phenomena to model and help us to get some input data and to experiment with the most recent models. On the other hand, our partners get interactive virtual prototypes that help them testing different hypothesis and enable a visual appreciation of their results. In particular, our aims are to:

- Improve interactive animation techniques for all kinds of physical models.
- Develop models for new individual phenomena.
- Work on the interaction between phenomena of different nature, such as forest and wind, sand and water, erosion (wind, water and landscape) or even eco-systems (soil, water, plants and animals).

2.4. Efficient visualization of very large scenes

Being able to handle massive data sets has been a strategic objective for French Computer Science for the last few years. In our research field, this leads us to investigate both the scientific visualization of very large data sets (which helps exploring and understanding the data provided, for instance, by our scientific partners from other research fields), and the real-time, realistic rendering of large size natural scenes, seeking for the interactive exploration and possible immersion in such scenes as a long term goal. More precisely, our objectives are to develop:

- Novel methods for the interactive visualization of complex, hybrid massive data sets, possibly embedding 1D and 2D structures within volumetric data which may represent scalar, vector or tensor fields.
- Perception based criteria for switching between levels of detail or between the representations of different nature we use in multi-models.
- Real-time techniques enabling us to achieve the rendering of full, natural scenes by exploring new, non-polygonal representations and relying on the programmable graphics hardware whereas possible.

2.5. Highlights of the year

Selected highligths:

- On Mai 21 2008, Olivier Palombi received an award from the Grenoble INP, for his PhD thesis untitled *Anatomical modeling using skeleton-based implicit surfaces.*, prepared under the supervision of Marie-Paule Cani and defended in December 2006. Note that Olivier Palombi, Neurosurgeon and lecturer in Anatomy at Grenoble University, joined EVASION as a permanent member of EVASION in September 2007.
- Marie-Paule Cani was elected **Director at large** within the executive committee of ACM SIGGRAPH, for three years. Her duty started in July 2008.
- François Faure defended his *Habilitation à diriger des recherches* [3]
- Fabrice Neyret became CNRS Research Director in October 2008.

3. Scientific Foundations

3.1. Methodology

The synthesis of natural scenes has been studied long after that of manufacturing environments in Computer Graphics, due to the difficulty in handling the high complexity of natural objects and phenomena. This complexity can express itself either in the number of elements (e.g., a prairie, hair), in the complexity of the shapes (e.g., some vegetal or animal organisms) and of their deformations (a cloud of smoke), from motions (e.g., a running animal, a stream), or from the local appearance of the objects (a lava flow). To tackle this challenge:

- we exploit *a priori* knowledge from other sciences as much as possible, in addition to inputs from the real world such as images and videos;
- we take a transversal approach with respect to the classical decomposition of Computer Graphics into Modeling, Rendering and Animation: we instead study the modeling, animation and visualization of a phenomenon in a combined manner;
- we reduce computation time by developing alternative representations to traditional geometric models and finite element simulations: hierarchies of simple coupled models instead of a single complex model; multi-resolution models and algorithms; adaptive levels of detail;
- we take care to keep the user in the loop (by developing interactive techniques whereas possible) and to provide him/her with intuitive control;
- we validate our results through the comparison with the real phenomena, based on perceptual criteria.

3.2. Research strategies

Our research strategy is twofold:

- **Development of fundamental tools**, i.e., of new models and algorithms satisfying the conditions above. Indeed, we believe that there are enough similarities between natural objects to factorize our efforts by the design of these generic tools. For instance, whatever their nature, natural objects are subject to physical laws that constrain their motion and deformation, and sometimes their shape (which results from the combined actions of growth and aging processes). This leads us to conduct research in adapted geometric representations, physically-based animation, collision detection and phenomenological algorithms to simulate growth or aging. Secondly, the high number of details, sometimes similar at different resolutions, which can be found in natural objects, leads us to the design of specific adaptive or multi-resolution models and algorithms. Lastly, being able to efficiently display very complex models and data-sets is required in most of our applications, which leads us to contribute to the visualization domain.
- **Validation of these models by their application to specific natural scenes**. We cover scenes from the animal realm (animals in motion and parts of the human body, from internal organs dedicated to medical applications to skin, faces and hair needed for character animation), the vegetal realm (complex vegetal shapes, specific material such as tree barks, animated prairies, meadows and forests) and the mineral realm (mud-flows, avalanches, streams, smoke, cloud).

4. Application Domains

4.1. Introduction

The fundamental tools we develop and their applications to specific natural scenes are opportunities to enhance our work through collaborations with both industrial partners and scientists from other disciplines (the current collaborations are listed in Section 7 and 8). This section briefly reviews our main application domains.

4.2. Audiovisual applications: Special effects and video games

The main industrial applications of the new representation, animation and rendering techniques we develop, in addition to many of the specific models we propose for natural objects, are in the audiovisual domain: a large part of our work is used in joint projects with the special effects industry and/or with video games companies.

4.3. Medical applications: Virtual organs and surgery simulators

Some of the geometric representations we develop, and their efficient physically-based animations, are particularly useful in medical applications involving the modeling and simulation of virtual organs and their use in either surgery planning or interactive pedagogical surgery simulators. All of our applications in this area are developed jointly with medical partners, which is essential both for the specification of the needs and for the validation of results.

4.4. Environmental applications and simulation of natural risks

Some of our work in the design and rendering of large natural scenes (mud flows, rock flows, glaciers, avalanches, streams, forests, all simulated on a controllable terrain data) lead us to very interesting collaborations with scientists of other disciplines. These disciplines range from biology and environment to geology and mechanics. In particular, we are involved in inter-disciplinary collaborations in the domains of impact studies and simulation of natural risks, where visual communication using realistic rendering is essential for enhancing simulation results.

4.5. Applications to industrial design and interactive modeling software

Some of the new geometrical representations and deformation techniques we develop lead us to design novel interactive modeling systems. This includes for instance applications of implicit surfaces, multiresolution subdivision surfaces, space deformations and physically-based clay models. Some of this work is exploited in contacts and collaborations with the industrial design industry.

4.6. Applications to scientific data visualisation

Lastly, the new tools we develop in the visualisation domain (multiresolution representations, efficient display for huge data-sets) are exploited in several industrial collaborations involving the energy and drug industries. These applications are dedicated either to the visualisation of simulation results or to the visualisation of huge geometric datasets (an entire power plant, for instance).

5. Software

5.1. Introduction

Although software development is not among our main objectives, the various projects we are conducting lead us to conduct regular activities in the area, either with specific projects or through the development of general libraries.

5.2. Sofa

Participants: Michael Adam, Guillaume Bousquet, Florent Falipou, François Faure, Lenka Jeřábková, Matthieu Nesme.

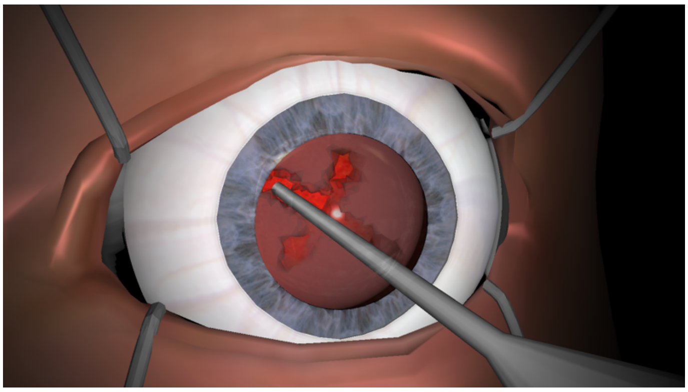

Figure 1. Simulation of cataract surgery using SOFA at interactive rates (about 50Hz).

SOFA is a C++ library primarily targeted at medical simulation research. Based on an advanced software architecture, it allows to (1) create complex and evolving simulations by combining new algorithms with algorithms already included in SOFA; (2) modify most parameters of the simulation – deformable behavior, surface representation, solver, constraints, collision algorithm, etc. – by simply editing an XML file; (3) build complex models from simpler ones using a scene-graph description; (4) efficiently simulate the dynamics of interacting objects using abstract equation solvers; and (5) reuse and easily compare a variety of available methods (see Figure 1).

SOFA has been part of a collaborative Virtual Reality demonstration at the VRST exhibition in Bordeaux, October 2008. It has been used as software platform for several publications of the team [17], [19].

5.3. MobiNet

Participants: Michael Adam, Franck Hétroy, Fabrice Neyret.

The MobiNet software allows for the creation of simple applications such as video games, virtual physics experiments or pedagogical math illustrations. It relies on an intuitive graphical interface and language which allows the user to program a set of mobile objects (possibly through a network). It is available in public domain for Linux, Windows and MacOS at http://mobinet.inrialpes.fr. It originated from 4 members of EVASION and ARTIS. The main aim of MobiNet is to allow young students at high school level with no programming skills to experiment, with the notions they learn in math and physics, by modeling and simulating simple practical problems, and even simple video games. This platform has been massively used during the Grenoble INP "engineer weeks" since 2002: 150 senior high school pupils per year, doing a 3 hour practice. This work is partly funded by Grenoble INP. Various contacts are currently developed in the educational world. Besides "engineer weeks", several groups of "monitors" PhD students conducts experimentations based on MobiNet with a high scool class in the frame of the courses. Moreover, presentation in workshops and institutes are done, and a web site repository is maintained.

This year, we obtained an LJK founding for 6 monthes of ingeneer which allowed us (with collaboration of the SED service) to port MobiNet to various OS with a decent packaging, and to delivered the new version 1.1.100. Moreover, we presented the software and our pedagogical experiments at APMEP'08, the French national conference of maths teachers.

5.4. Proland

Participants: Eric Bruneton, Antoine Begault, Adyl Kenouche.

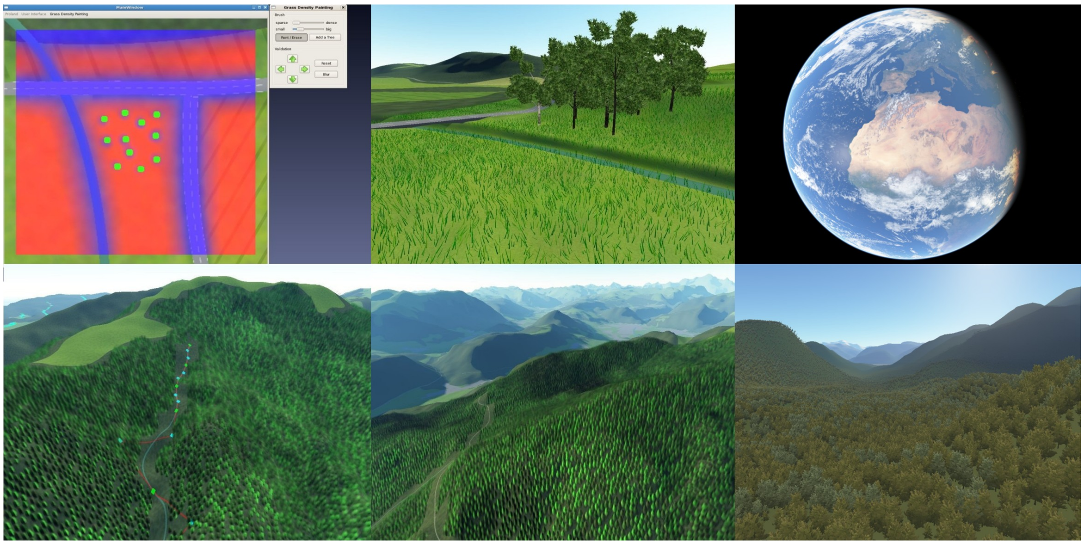

Figure 2. Proland software

Proland (for *procedural landscape*) is a software platform originally developed for the NatSim project (see Section 8.2.2). This year it has also been developped using fundings from the GVTR project (see Section 7.2), and it is the basis for our participation in the MarketSimGame project (see Section 7.6). The goal of this platform is the real-time rendering and editing of large landscapes. It currently integrates several results of the EVASION project-team on top of a terrain rendering algorithm: grass, individual animated trees, forests (using volumetric textures or billboard clouds), as well as atmospheric effects (see Section 6.3.6). The terrain data can come from digital sources (satellite photographs) and from vector data (spline curves representing roads, rivers, fields, forests, etc). The vector data can be edited in real-time and can be used to constrain the vegetation. A new, more modular and extensible version has been started this year. Currently only the terrain renderer, the billboard cloud forests and the atmospheric effects have been ported to this new version. The main new feature of this version is that it can work with planet-sized terrains, for all viewpoints from ground to space. Both versions have been deposited to APP (Deposit numbers IDDN.FR.001.390029.000.S.C.2008.000.31500 and IDDN.FR.001.390030.000.S.P.2008.000.31500).

5.5. MaTISSe

Participants: Adrien Bernhardt, Marie-Paule Cani, Olivier Palombi, Adeline Pihuit.

MaTISSe is a software dedicated to free form shape Modeling through Interactive Sketching and Sculpting gestures. The goal is to provide a very intuitive way to create 3D shapes, as easy to use for the general public as roughly sketching a shape or modeling it with a piece of clay. Our first prototype was developed in 2007-2008, in the framework of a research contract with the company Axiatec 7.4. It enables to create a 3D shape by smoothly blending different components, which are progressively painted at different scales and from different viewing angles. See Figure 3. Our prototype is written in C++ as an extension of the Ogre open-source library. It relies on our recent research sketch-based modeling using geometric skeletons and convolution surfaces 6.1.3. Future extensions will include the combination of sketching with modeling gestures related to clay sculpting, such as deforming a shape through Pulling, pushing, bending or twisting gestures.

Figure 3. Matisse: a free-form shape modeling tool for non-experts, based on a 2D painting metaphor.

6. New Results

6.1. Modeling, editing and processing geometry

Participants: Sébastien Barbier, Adrien Bernhardt, Georges-Pierre Bonneau, Marie-Paule Cani, François Faure, Sahar Hassan, Franck Hétroy, Olivier Palombi, Adeline Pihuit, Damien Rohmer, Jamie Wither.

6.1.1. Multiresolution geometric modeling with constraints

Participants: Sébastien Barbier, Georges-Pierre Bonneau.

This work is done in collaboration with Stefanie Hahmann from LJK. A collaboration is also taking place on this topic with Prof. Gershon Elber from Technion. The purpose of this research is to allow complex nonlinear geometric constraints in a multiresolution geometric modeling. This year we have two publications. The first is dedicated to the preservation of volume inside a multiresolution BSpline tensor-product surface [10]. This is illustrated in Figure 4. It has been published in the journal CAGD (Elsevier). The second work is a state of the art on the modeling of smooth complex surfaces interpolating an arbitray mesh [18], published at ASME2008.

6.1.2. Virtual sculpture

Participants: Adrien Bernhardt, Marie-Paule Cani, Adeline Pihuit.

The layered volumetric model we previously developed for virtual clay achieves the desired plausibility in real-time, but opens the problem of providing intuitive interaction tools. Our recent work therefore focused on developing new interfaces for interacting with virtual clay, and in particular interfaces that enable us to intuitively control a virtual hand interacting with the clay.

We first developed a prototype where a soft ball attached to a force feedback device (phantom) serves as an avatar for the virtual clay. The ball is augmented with force sensors, to ease the control of the deformable virtual hand that sculpts the clay. This enabled us to identify several issues, such as the restriction to small gestures, and the fatigue due to the fact that a constant pressure needed to be applied to hold an object.

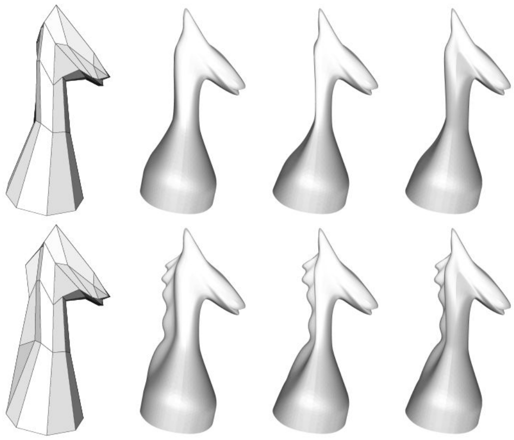

Figure 4. Deformation of a uniform B-spline surface with Volume Preservation. Frome left to right : control polyhedrons; initial surfaces; the volume is free; the volume is preserved.

We then developed a new interaction device, called **Hand Navigator** as it is an extension of a space ball [20]. The users hand lies on the space-ball, augmented with cavities equipped with force sensor for each fingers. The user controls virtual hand gestures by applying two directional pressure forces with his/her fingers, and by controlling the overall motion and orientation of the virtual hand with the palm. This both enables gestures that are not limited in scope and avoids fatigue, since the users hand remains in a rest position. See Figure 5. We conducted a series of user studies for validation.

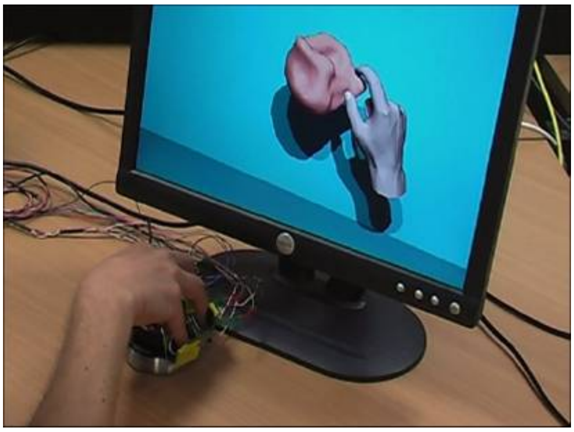

Figure 5. Hand-Navigator: a new device for interacting with virtual clay.

This project resulted into an INRIA patent registered in July 2008, and a pre-industrialization project funded in 2008-2009 by the incubator GRAVIT (see Section 7.3). Note that this project is part of our contribution to the PPF "Multimodal interaction" (see Section 8.3.1).

6.1.3. Sketch-Based Modeling

Participants: Adrien Bernhardt, Marie-Paule Cani, Olivier Palombi, Adeline Pihuit, Jamie Wither.

Sketch-based 3D modeling is currently attracting more and more attention, being recognized as a fast and intuitive way of creating digital content. We are exploring this technique from two different view-points:

A first class of methods directly infer free-form shapes in 3D from arbitrary progressive sketches, without any a priori knowledge on the objects being represented. In collaboration with Loic Barthes from the IRIT lab in Toulouse, we studied the use of convolution surfaces for achieving this goal [20]: the user paints a 2D projection of the shape. A skeleton (or medial axis), taking the form of a set of branching curves, is reconstructed from this 2D region. It is converted into a close form convolution surface whose radius varies along the skeleton. The resulting 3D shape can be extended by sketching over it from a different viewpoint, while the blending operator used adapts its action so that no detail is blurred during the process. This work was supported by a direct industrial contract with the firm Axiatec (see Section 7.4), leading to the development of the MaTISSe software (see Section 5.5). This work will be continued within Adeline Pihuits PhD project, co-supervised by Olivier Palombi and Marie-Paule Cani, and focusing on the use of sketch-based interfaces for the interactive teaching of anatomy.

Other sketching techniques are able to create a complex shape from a single sketch, using some a priori knowledge on the object being drawn for inferring the missing 3D information. This was the topic of Jamie Wither's PhD thesis, advised by Marie-Paule Cani and defended in November 24, 2008. In 2008, we introduced the ideas of inferring the structure of a complex shape from its silhouette, of combining sketch-based control with the procedural modeling of details, and of being able to sketch fine details locally, and extend them to the whole shape. These ideas were exploited for the sketch-based modeling of clouds [24] (see Figure 6) and of trees (submitted to publication). This last work was conducted within the ANR Natsim (see Section 8.2.2), in collaboration with the INRIA project-team Virtual Plants (AMAP lab).

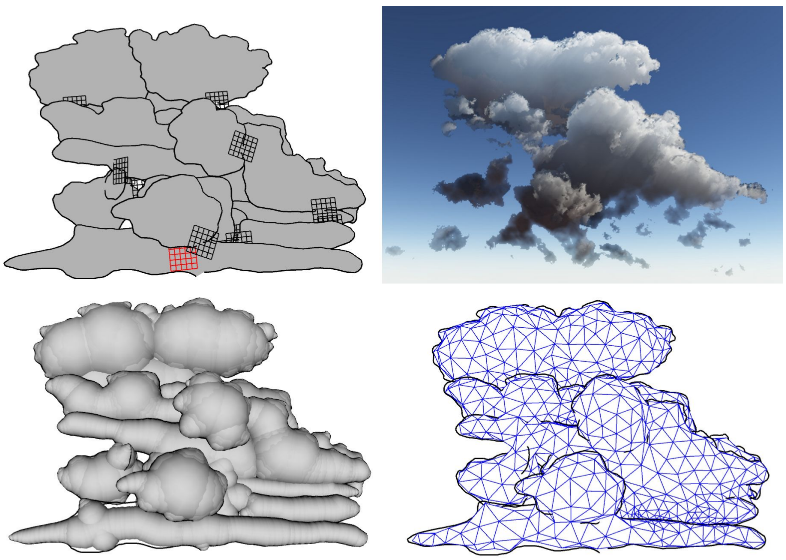

Figure 6. Use of different layers and combination with procedural details for the sketch-based modeling of cumulus clouds.

6.1.4. Geometrical methods for skinning character animations

Participants: Marie-Paule Cani, Franck Hétroy, Damien Rohmer.

Skinning, which consists in computing how vertices of a character mesh (representing its skin) are moved during a deformation w.r.t. the skeleton bones, is currently the most tedious part in the skeleton-based character animation process. We propose new geometrical tools to enhance current methods. First, we developed a new skinning framework inspired from the mathematical concept of atlas of charts: we segment a 3D model of a character into overlapping parts, each of them being anatomically meaningful (e.g., a region for each arm, leg, etc., with overlaps around joints), then during deformation the position of each vertex in an overlapping area is updated thanks to the movement of neighboring bones. This work (submitted to publication) was done in collaboration with Boris Thibert from the MGMI team of the LJK, Cédric Gérot and Annick Montanvert from the GIPSA-Lab in Grenoble, and Lin Lu from the University of Hong Kong.

Secondly, we developed, in collaboration with Stefanie Hahmann from the MGMI team of the LJK, a post-correction method for preserving volume in the standard smooth-skinning pipeline [9]. As usual, the character is defined by a skin mesh at some rest pose and an animation skeleton. At each animation step, skin deformations are first computed using standard SSD. Our method corrects the result using a set of local deformations which model the fold-over-free, constant volume behavior of soft tissues. This is done geometrically, without the need of any physically-based simulation. To make the method easily applicable, we also provide automatic ways to extract the local regions where volume is to be preserved and to compute adequate skinning weights, both based on the characters morphology.

6.1.5. Detection and quantification of brain aneurysms

Participants: François Faure, Sahar Hassan, Franck Hétroy, Olivier Palombi.

Aneurysms are excrescences on blood vessels. They can break, letting the blood propagate outside the vessel, which often leads to death. In some cases, the blood clots sufficiently fast so that people survive. However, a neurosurgeon or a neuroradiologist should intervene very quickly in order to repare the vessel before the aneurysm breaks once more.

The purpose of this research is to help neurosurgeons and neuroradiologists to plan surgery, by giving them quantitative information about the size, shape and geometry position of aneurysms. This work is part of the PhD of Sahar Hassan. In 2008 Sahar enhanced the method developed during her Master thesis, by adding partial graph matching to locate aneurysms on the cerebral vascular tree and give accurate information on the location and size of aneurysm's necks. This work has been evaluated by a radiologist at the Grenoble University Hospital. We plan to publish the method in the medical literature.

6.1.6. Reconstruction of the Linear Nucleus of the Medulla using interactive implicit modeling from tissues sections

Participants: Marie-Paule Cani, Olivier Palombi, Adeline Pihuit.

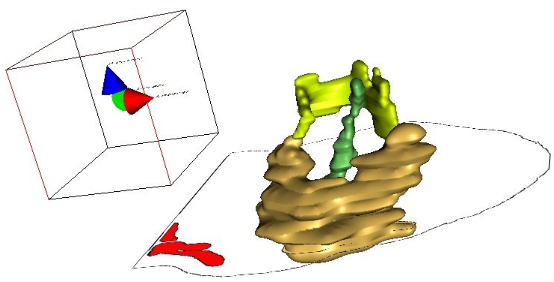

Figure 7. Reconstruction of the Linear Nucleus.

To reveal both three dimensional organization and function of brain structures, sectioning of biological material remains the only way. Noninvasive techniques such as current 3D imaging explorations cannot provide the necessary resolution. Our goal is to produce the most realistic models of the neuro-anatomical structures. We propose an interactive technique to reconstruct 3D shapes from manually contoured structures in 2D using skeletal implicit surfaces. The fields generated in each slice are blended over all sections to build the final 3D surface. The anatomist can change selectively contours to improve the relevance of the final model according to histological information contained in the tissues sections. The Figure 7 shows the Linear Nucleus (in green) as an example.

6.1.7. Mesh repair

Participant: Franck Hétroy.

This work is done in collaboration with Carlos Andujar, Pere Brunet and Alvar Vinacua from Universitat Politecnica de Barcelona, Spain. The purpose is to propose an efficient method to create 2-manifold meshes from real data, obtained as soups of polygons with combinatorial, geometrical and topological noise. We propose to use a voxel structure called a discrete membrane and morphological operators to compute possible topologies, between which the user chooses.

6.2. Animating nature

Participants: Sébastien Barbier, Eric Bruneton, Marie-Paule Cani, Mathieu Coquerelle, Julien Diener, Estelle Duveau, Florent Falipou, François Faure, Everton Hermann, Matthieu Nesme, Fabrice Neyret, Olivier Palombi, Cécile Picard, Lionel Reveret, Maxime Tournier, Xiaomao Wu, Qizhi Yu.

6.2.1. Highly colliding deformable bodies

Participants: Sébastien Barbier, Florent Falipou, François Faure, Everton Hermann.

We address the question of simulating highly deformable objects. We have focused on the collision detection and response between highly deformable bodies, where precomputed distance maps can not be used, and published two novel methods. The first, illustrated in Figure 8 one replaces a three-dimensional distance computation by a one-dimensional search along a ray, accelerated using an octree structure [19].

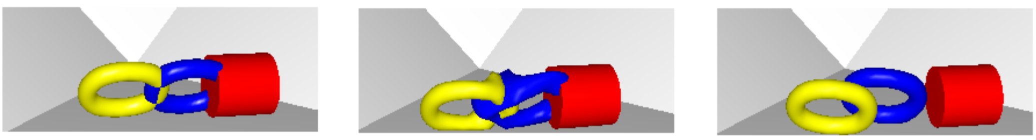

Figure 8. Simulation of highly deformable bodies in contact using our octree-based method. Left: initial state, center: proximity response, right: ray-trace response.

The second method [17], illustrated in Figure 9, replaces distance computations with intersection volume computations. A novel GPU-based method computes the intersection volume between objects, as well as its derivatives with respect to the surface vertices. This allows the efficient implementation of penalty forces.

6.2.2. Robust finite elements for deformable solids

Participants: François Faure, Matthieu Nesme.

Figure 9. Simulation of highly deformable bodies in contact using our GPU-based method.

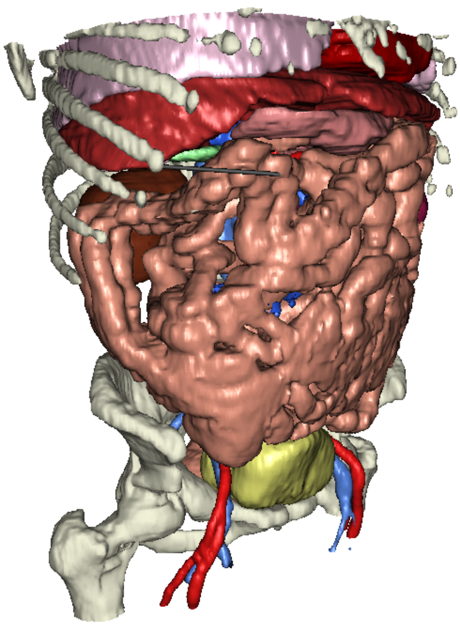

Figure 10. Snapshot of an interactive surgery simulation.

Matthieu Nesme has defended his Ph.D. [4] on robust finite element modeling for surgery simulation, in collaboration with laboratory TIMC. Its purpose is to develop new models of finite elements for the interactive physically-based animation of human tissue. His regular grid based FEM approach allows the easy modeling and interactive simulation of complex scenes based on medical images, as illustrated in Figure 10. He is now a post-doctoral student at University McGill, Montreal, Canada.

6.2.3. Sound synthesis

Participants: François Faure, Cécile Picard.

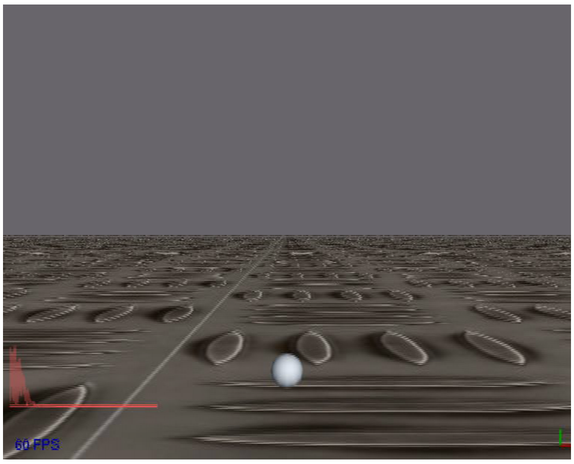

Figure 11. Textures can be used for audio synthesis.

Cécile Picard, a PhD. student, was previously in Sophia-Antipolis tutored by Nicolas Tsingos and George Drettakis. She has joined us in July, since Nicolas moved to Dolby Labs in California, and will be co-tutored by François Faure and George Drettakis during the rest of her thesis. We published a method for sound synthesis in game engines [22], where height profiles are extracted from textures and used as input to the sound generation module, as illustrated in Figure 11.

6.2.4. Real-time animation of liquids and river surfaces

Participants: Eric Bruneton, Marie-Paule Cani, Mathieu Coquerelle, Fabrice Neyret, Qizhi Yu.

Qizhi Yu is working on this topic as a Marie Curie PhD student (Visitor program), supervised by Fabrice Neyret and Eric Bruneton. The purpose is to obtain a realistical detailed appareance of landscape-long animated rivers in real-time, with user-editable features. The idea is to separate the river simulation into 3 scales, corresponding to different specification and simulation tools: macroscale for the topographic shape and global flow characteristics (relying on simple CFD at coarse resolution), mesoscopic scale for the local wave patterns (relying on dedicated phenomenological models), microscopic scale for the details (relying on textural procedural schemes). Note that this topic is included in the scope of the NatSim collaboration.

This year, we have developped a macroscopic model of rivers, allowing for the real-time visual simulation of a flow from close to far view on very large terrains (see Proland Project). A real-time editable vector description of river boundaries and obstacles is used to define a semi-analytic distance field which is use to derivate a zero-derivative flow. A screen-space Poisson-disk distribution of river particles carrying wave textures is animated and continuously readapted, so as to be space-time continuous (see Figure 12). A paper has been submmited.

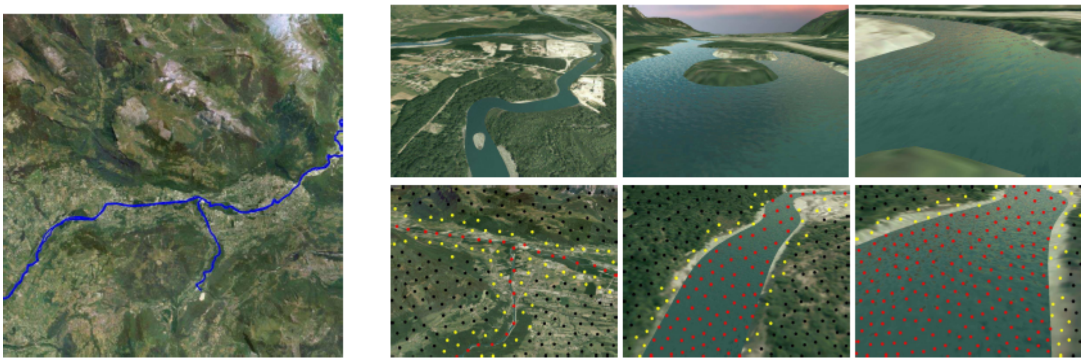

Figure 12. Our river animation and reconstruction model handles the real-time dynamic exploration from landscape-scale to close-scale. Advected particles obey a Poisson-disk distribution in screen space.

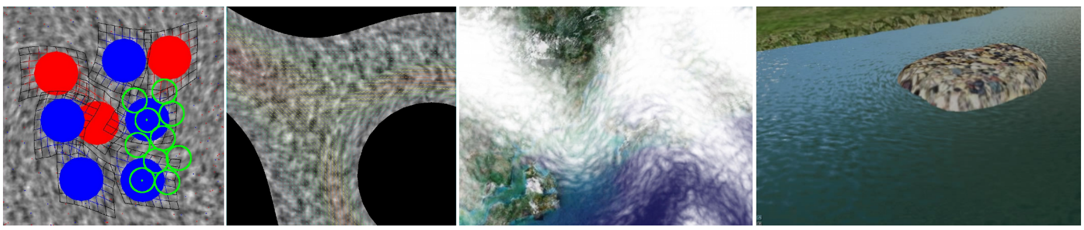

Figure 13. Our Lagrangian texture advection model allows local patches to be deformed and regenerated asymchroneously. This yields a better conformance to the appearant flow and to the texture spectrum properties at the same time.

Moreover, we have developped a Lagrangian model of texture advection, to be used for advecting small water surface details while preserving their spectral characteristics. Our particles are distributed according to animated Poisson-disk, and carry a local grid mesh which is distorted by advection and regenerated when a distorsion metrics is passed. This Lagrangian approach solve the problem of local-adaptive regeneration rate, provide a better spectrum and better motion illusion, and avoid the burden of blending several layers (see Figure 13). A paper has been submmited.

Qizhi defended his PhD in November 2008 [6].

The PhD of Mathieu Coquerelle [2], advised by Georges-Henri Cottet and co-advised by Marie-Paule Cani, explored the use of vortex particules for animating liquids and gases and to simulate their interactions with rigid solids. It was defended in September 2008.

6.2.5. Motion capture of small vertebrates

Participants: Estelle Duveau, Olivier Palombi, Lionel Reveret, Xiaomao Wu.

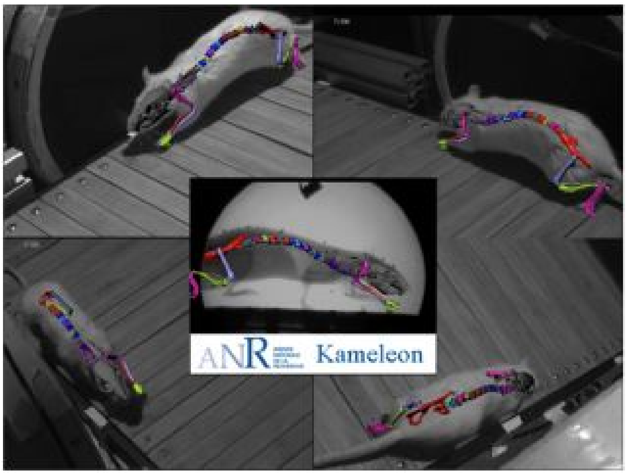

Figure 14. Motion capture of small vertebrates.

The ANR project Kameleon has driven several research topics towards the achievement of motion capture of small vertebrates. Works have been done to collect 3D scanner data of rat skeleton at very high resolution (up to 50 microns thanks to an experiment approved at the European Synchrotron Radiation Facility). The huge amount of tomography data has motivated development for GPU-based algorithm of surface segmentation. Anatomical skeletons have been processed to provide hierarchical skeleton for animation and registered onto video data. Several experiments have been conducted at the Museum National dHistoire in Paris to collect video data. Estelle Duveau has started a PhD on motion capture from 3D surface flow. This PhD is co-advised by Lionel Reveret and U. Descartes, Paris 5. A clinical study is currently under investigation using techniques developed during the project and will be published in 2009.

6.2.6. Motion capture of animals in outdoor conditions

Participant: Lionel Reveret.

Projects have been started to develop method adapted to the motion capture of animals in outdoor conditions. A pioneer study has been done for greyhound dogs. The goal is to set-up a scientific campaign to perform motion capture in a wild life reserve in Africa.

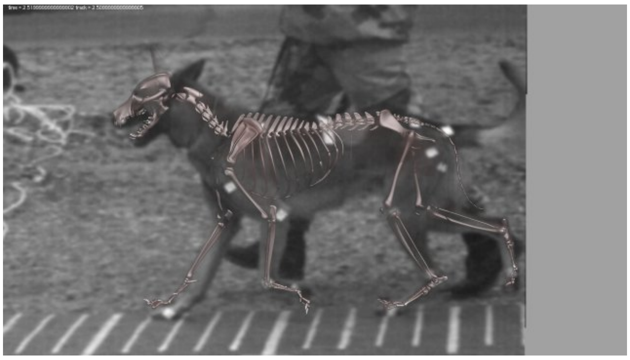

Figure 15. Motion capture of animals in outdoor conditions.

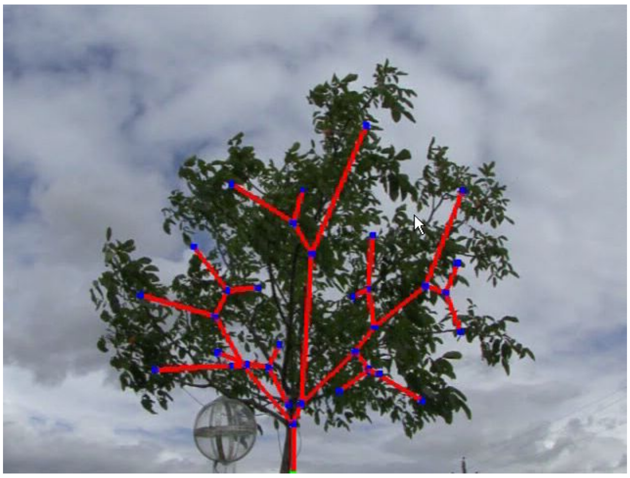

Figure 16. Motion capture of trees under wind.

6.2.7. Motion capture of trees under wind

Participants: Julien Diener, Lionel Reveret.

These works are carried on in the context of the ANR project Chêne-Roseau. The goal is to validate measurement tool from video to evaluate the risk of breaking of fruit trees under strong wind. Several experiments have been done in collaboration with INRA at Clermont-Ferrand (UMR PIAF). In parallel, a work on modal analysis of tree structure and its application to real-time animation had been developed will be published at EG09.

6.2.8. Modeling motion capture data of human

Participants: Lionel Reveret, Maxime Tournier, Xiaomao Wu.

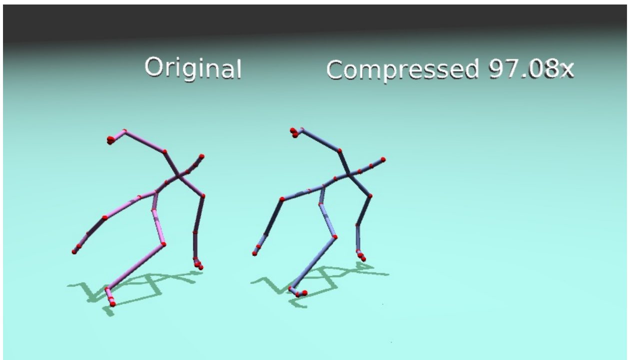

Figure 17. Modeling motion capture data of human.

Collaboration has been developed with the University of Montreal to address the problem of fall detection of elderly people. This work has been published at EMBC08. A continuation of this work is currently under investigation to integrate statistical descriptor of motion proposed in 2004 by Favreau et al. (SCA04) In addition, works on mathematical modeling of quaternionic signals arising from motion capture have been investigate within the context of the ARC project Fantastik. These works have lead to two INRIA Research Report and one paper will be published at EG09. Finally, works have been done on expressive facial animation with the Psychology Department of the University of Geneva. A journal paper is currently under preparation.

6.3. Efficient visualization of very large scenes

Participants: Yacine Amara, Sébastien Barbier, Georges-Pierre Bonneau, Christian Boucheny, Antoine Bouthors, Eric Bruneton, Philippe Decaudin, Thomas Félix, Fabrice Neyret.

6.3.1. Visualisation of large numerical simulation data sets

Participants: Sébastien Barbier, Georges-Pierre Bonneau, Thomas Félix.

Visualization of the results of scientific simulations is crucial in order to gain understanding of the phenomena that are simulated. The visualization techniques need to be interactive - if not real time - to be helpful for engineers. Therefore multiresolution techniques are required to accelerate the visual exploration of the data sets. Sébastien Barbier and Thomas Felix have developed a set of GPU implemented algorithms that enable to dynamically extract a BiResolution mesh from any given tetrahedral mesh. A specific out-of-core simplification algorithm is performed in preprocessing. During exploration of the data, a single consistent mesh is extracted on-the-fly from a Volume-Of-Interest (VoI) and a coarse contextual mesh outside the VoI. Massive tetrahedral mesh can be visualized interactively on a desktop PC. Figure 18 illustrates the approach. The results have been presented in two poster sessions at Pacific Visualization 2008 and Pacific Graphics 2008 and in the paper [12].

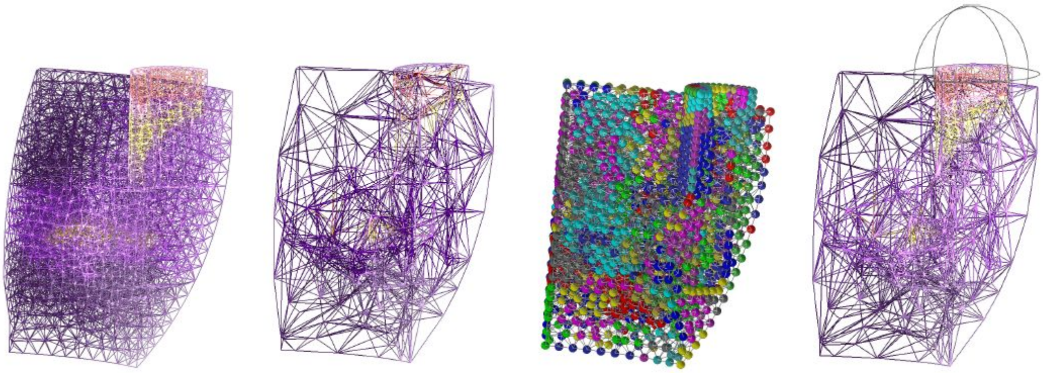

Figure 18. BiResolution Visualization of Tetrahedral Meshes. From left to right: fine tetrahedral mesh, coarse mesh, Mesh partition, BiResolution mesh with VoI.

6.3.2. Perceptive Visualization

Participants: Georges-Pierre Bonneau, Christian Boucheny.

This project is part of a collaboration with EdF R& D, and with LPPA (Laboratoire de Physiologie de la Perception et de l'Action, Collège de France). EdF runs massive numerical simulations in hydrodynamics, mechanics, thermodynamic, neutronic... Postprocess, and in particular visualization of the resulting avalanche of data is a bottleneck in the engineering pipeline. Contrary to the numerical simulation itself, this postprocessing is human-time consuming, with engineers spending several hours to explore the result of their simulation, trying to catch the knowledge hidden behind the numbers computed by the simulation. The focus of our collaboration with EdF and the College de France is to incorporate our knowledge of the human visual perception system in the development of more efficient visualization techniques. We also deal with the evaluation of existing visualization algorithms, based on perceptive criteria.

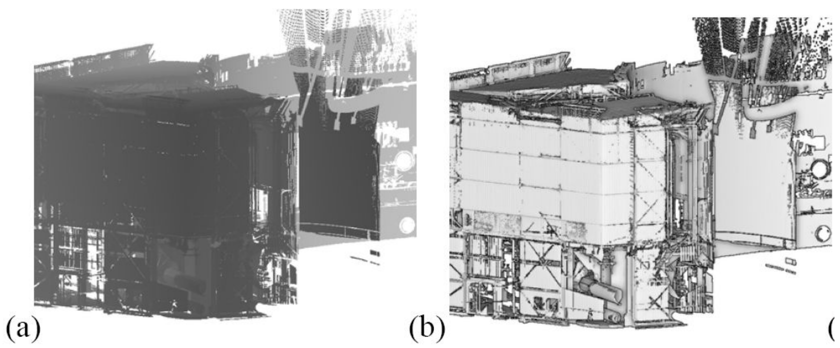

Figure 19. Hidden Point Removal and Eye Dome Lighting of a dense cloud of points. Left: point cloud, Right: rendering using HPR and EDL

This year a journal paper at ACM Transactions on Applied Perception has been accepted [7], about the perceptive evaluation of volume rendering algorithms. Christian Boucheny has also developed two rendering techniques taking into account perceptive criteria. First he has proposed a novel shading algorithm, called EyeDomeLighting (EDL), simulating ambient occlusion in image-space, that augment our perception of depth in arbitrary 3D data. Second he has introduced a new Hidden Point Removal (HPR) algorithm that takes as input a cloud of scattered 3D points, and outputs a subset of this cloud which intuitively simulate an opaque surface interpolating the cloud of points. Figure 19 illustrates the HPR and EDL shading on a dense 3D set of points.

6.3.3. *Efficient representation of landscapes*

Participants: Eric Bruneton, Fabrice Neyret.

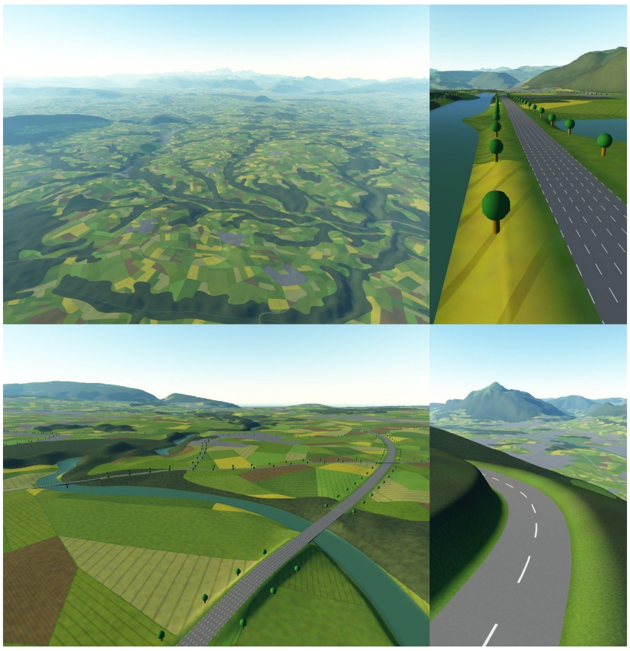

Figure 20. Real-time rendering and editing of large landscapes

The goal of this work is the real-time rendering and editing of large landscapes with forests, rivers, fields, roads, etc. with high rendering quality, especially in term of details and continuity. A first step toward this goal is the modeling, representation and rendering of the terrain itself. Since an explicit representation of the whole terrain elevation and texture at the maximum level of detail would be impossible, we generate them procedurally on the fly (completely from scratch or based on low resolution digital elevation models). Our main contribution in this context is to use vector-based data to efficiently and precisely model linear features of the landscape (such as rivers, hedges or roads), from which we can compute in real-time the terrain texture and the terrain elevation (in order to correctly insert roads and rivers in the terrain - see Figure 20). This work has been published at the Eurographics conference [16].

6.3.4. *Efficient representation of plants and trees*

Participants: Philippe Decaudin, Fabrice Neyret.

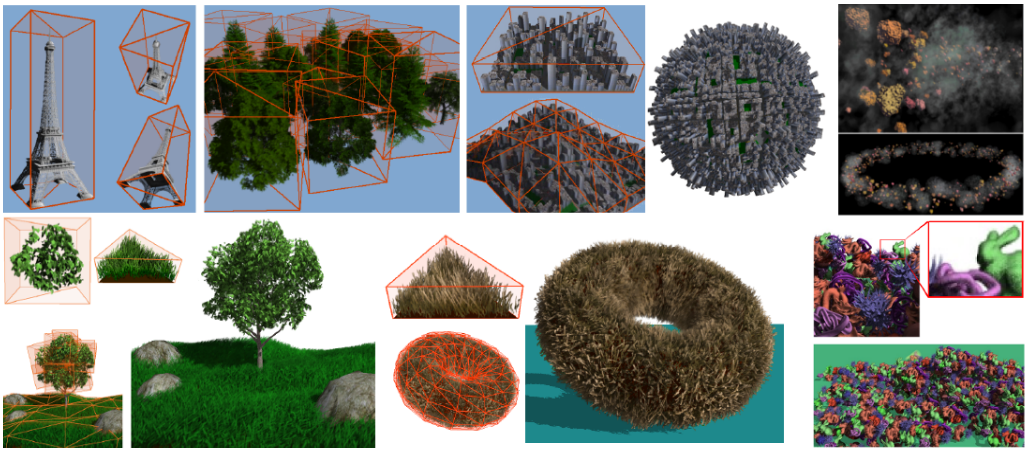

Figure 21. Our Volumetric Billboards model allows us to represent very complex detailled scenes very efficiently and with high visual quality, handling a volumetric-wise filtering of 'geometry'.

We developped a new representation for the efficient representation and filtering of complex data, typically, vegetal elements in a landscape. The volumetric Billboard, which is based on a multiscale volume of voxels. Our rendering algorithm is able to render seemlessly and efficiently a complex self-intersecting distribution of such base volumes relying on common adaptive slicing of then parallel to screen. Equivalent mesh-based seen are more costly to render, more prone to aliasing. Moreover, Volumes allow to properly define the filtering of thin objects (which become fuzzy), see Figure 21. A paper has been submmited.

6.3.5. Real-time quality rendering of clouds

Participants: Antoine Bouthors, Eric Bruneton, Fabrice Neyret.

Figure 22. Real-time high quality rendering of detailled animatable clouds, taking into account anisotropic multiple Mie scattering.

Antoine Bouthors defended his PhD in June 2008 [1]. His last work on real-time high-quality rendering of cumuls clouds (without precomputation so as to allow for their animation), see Figure 22 has lead to a paper at

I3D'08 [14]. The model seems to interest the atmospheric physic community, so a journal submission in this field is under preparation. Note that Antoine has been hired by Weta Digital (New Zealand), and will continue working on atmospheric phenomena in the scope of special effects.

6.3.6. Atmosphere rendering

Participants: Eric Bruneton, Fabrice Neyret.

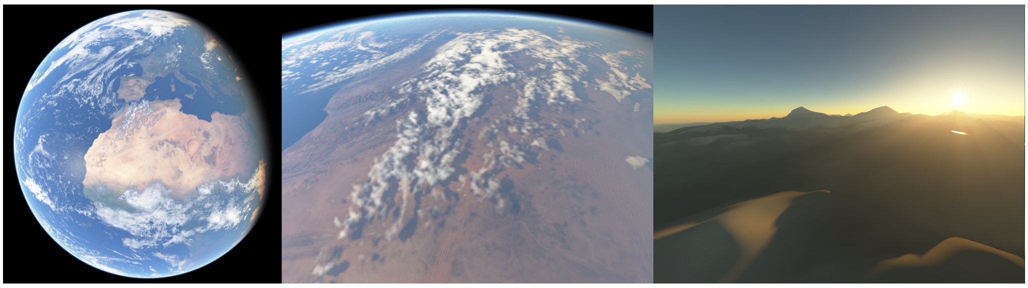

Figure 23. Real-time rendering of the atmosphere. Our method supports all light directions, all viewpoints from ground to space, and simulates multiple scattering and light shafts (see right image).

The goal of this work is the real-time and accurate rendering of the atmosphere from any viewpoint from ground level to outer space, while taking Rayleigh and Mie multiple scattering into account. Our method reproduces many effects of the scattering of light, such as the daylight and twilight sky color and aerial perspective for all view and light directions, or the Earth and mountain shadows (light shafts) inside the atmosphere. Our method is based on a formulation of the light transport equation that is precomputable for all view points, view directions and sun directions. We show how to store this data compactly and propose a GPU compliant algorithm to precompute it in a few seconds. This precomputed data allows us to evaluate at runtime the light transport equation in constant time, without any sampling, while taking into account the ground for shadows and light shafts (see Figure 23). This work has been published at the Eurographics Symposium on Rendering (EGSR) [15].

This work was limited to clear sky conditions. We studied how this method could be extended to support clouds. We have designed and implemented a physical simulator to find, among all the interactions bewteen the clouds, the atmosphere and the ground, the ones that are really important for visual realism, and those that can be neglected. We have found the important effects, but did not have time to propose a method to simulate them in real-time. A new Master thesis proposal has been submitted to continue this work next year.

6.3.7. Plant instancing on planet-sized terrains

Participants: Yacine Amara, Eric Bruneton.

The goal of this work is to render in real time planet-sized terrains populated with plants and trees. Since it is not possible to precompute and store the position of each plant (there are billions of them) we generate them on the fly. For this we generate candidate positions with a pseudo random generator, and we test each candidate against a land cover classification (LCC) map in order to reject all positions that fall outside vegetation areas (our Earth LCC map is quite coarse - 1 km per pixel - so we amplify it on the fly with procedural noise to add small scale variations). We then pack the validated positions using a GPU stream reduction algorithm, and we use this packed structure to draw many (> 100000) plant instances with appropriate LOD using hardware instancing (see Figure 24). This work was done by Yacine Amara as part of his PhD, during a five months visit in the EVASION team, based on previous work done in collaboration with Xavier Marsault in 2007. The result has been integrated in the new version of Proland (see Section 5.4).

Figure 24. Forests and isolated trees instanced and rendered with billboard clouds using our instancing algorithm, seen from several altitudes.

6.4. Applications covered by this year's results

The above sections presented our research in terms of fundamental tools, models and algorithms. A complementary point of view is to describe it in terms of application domains. The following sections describe our contribution to each of these domains, with references to the tools we relied on if they were already presented above.

6.4.1. Interactive modeling systems

Participants: Adrien Bernhardt, Marie-Paule Cani, Adeline Pihuit, Jamie Wither.

Several of the tools we are developing are devoted to a new generation of interactive modeling systems, following the general methodology based on sculpting and sketching metaphors described in the book [25]:

- The real-time physically-based model for virtual clay presented in Section 6.1.2 is dedicated to a sculpting system as close as possible to interaction with real clay.
- The sketching tools presented in Section 6.1.3 addressed both the design of general free form shapes and the combination of a sketch-based interface with a priori knowledge on the object being modeled. They were used in the industrial contract with Axiatec (see Section 7.4).

We are currently working at ways to combine both techniques, in other to inspire from sketching for initial shape design, and from sculpting techniques for further deformation.

6.4.2. Synthesis of natural scenes

Participants: Antoine Bouthors, Eric Bruneton, Marie-Paule Cani, Mathieu Coquerelle, Philippe Decaudin, Fabrice Neyret, Qizhi Yu.

Many of the diverse fundamental tools we are developing (see Sections 6.3.3, 6.3.6, 6.3.7) are contributing to the long term, general goal of modeling and animating natural scenes. They can be combined to allow the large scale specification, efficient rendering and animation of landscapes (rivers and cloudy skies, etc). The synthesis of complete natural sceneries is one of the aims of the NatSim project (see Section 8.2.2).

6.4.3. Medical applications

Participants: Guillaume Bousquet, Marie-Paule Cani, Florent Falipou, François Faure, Sahar Hassan, Franck Hétroy, Lenka Jeřábková, Matthieu Nesme, Olivier Palombi, Adeline Pihuit.

Some of our work on geometric modeling and physically-based animation has been successfully applied to the medical domain.

Our tools for efficient physically-based simulation, and in particular our new contributions to collision detection and response (see Section 6.2.1), as well as Matthieu Nesme's Ph.D. (see Section 6.2.2 are being used in a new European medical project called *Passport for Liver Surgery* (see Section 8.1.1).

7. Contracts and Grants with Industry

7.1. Collaboration with AMD/ATI and Nvidia Graphics board constructors

Participants: Fabrice Neyret, Lionel Reveret.

We are still in close contact with the AMD/ATI and Nvidia development teams providing suggestions and bug reports, and testing prototype boards.

7.2. GVTR (GeoVisualisation en Temps Réel)

Participants: Eric Bruneton, Fabrice Neyret.

GRAVIT is a Rhône-Alpes region consortium aiming at maturating research results in order to help their industrialization, typically by supporting the development of platforms. EVASION participated to the GRAVIT project GVTR (GeoVisualisation en Temps Réel) with ARTIS and REVE INRIA project-teams. The goal was to obtain a real-time engine in which it is easy to plug new research results. The duration was 1 year (October 2006 to September 2007), extended to August 2008. In this context we developped a new version of Proland (see Section 5.4), which will be used in the industrial project MarketSimGame (see Section 7.6) and maybe in other industrial projects (we currently have discussions with two potential partners).

7.3. GRAVIT Hand Navigator

Participants: Adrien Bernhardt, Marie-Paule Cani, Jean-Claude Leon.

We obtained another one year funding from the consortium GRAVIT, from September 2008 to September 2009, to prepare the industrialization of our new interaction device, the Hand-Navigator (see Section 6.1.2. A patent was issued in June 2008 by INRIA to protect this invention.

7.4. Axiatec

Participants: Adrien Bernhardt, Marie-Paule Cani, Adeline Pihuit.

The company Axiatec, which sells 3D printers in France, funded us from November 2006 to May 2008 for developing a 3D modelling system based on a very intuitive sketch-based technique, in order to enable the general public to model 3D shapes. See section 6.1.3 for a description of our research work related to this project.

7.5. GENAC

Participants: Michael Adam, François Faure, Antonin Fontanille, Lionel Reveret.

The GENAC project is supported by the "Pôle de Compétitivité Imaginove" from Lyon. The goal of this project is to develop procedural tools for the animation of virtual characters and rendering of complex lighting in the specific case of video games. Participants are EVASION project, ARTIS project, LIRIS laboratory in Lyon 1, Eden Games and Widescreen Games (video games companies in Lyon). The role of EVASION is specifically to provide procedural tools to combine motion capture data and physical simulation of 3D characters. Works on compression of motion capture database by Maxime Tournier in his Master Research will be extended to integrate physical parameters. For this goal, Michael Adam has achieved an adaptation of the SOFA library to handle articulated rigid body dynamics in the context of the GENAC project. Early results on jumps are illustrated in Figure 25.

7.6. MarketSimGame

Participants: Eric Bruneton, Adyl Kenouche.

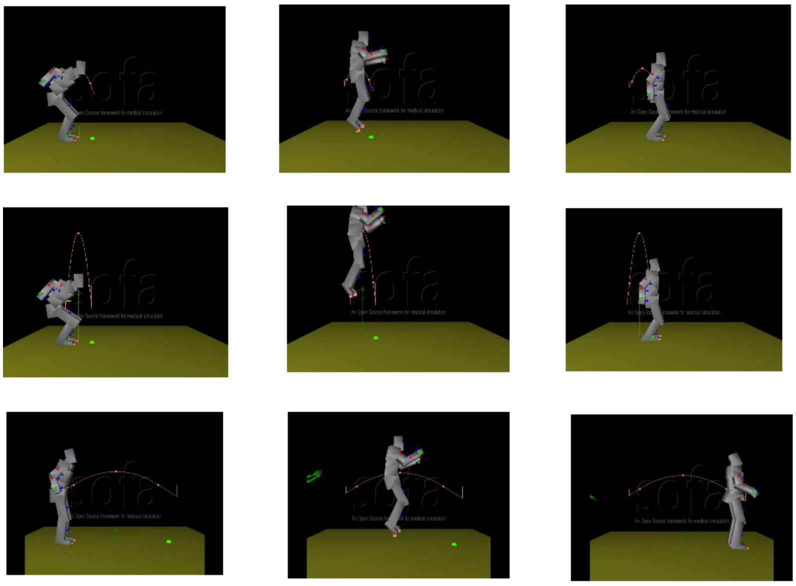

Figure 25. Snapshots of jumps of various length and height and planned online.

The MarketSimGame project is a Serious Game project between 3 industrial partners (VSM, PointCube, Heliotrope) and INRIA. It is funded by the DGE ("Direction Générale des Entreprises") as a "Pôle de Compétitivité" project labelled by Imaginove and Pégase. It officially started on March 05, 2008, and will end on July 04, 2010 (28 months). The goal of this project is to develop a marketing tool to promote new or existing aircrafts, thanks to technico-economic simulations. The Serious Game aspect is used to get a better marketing impact. It involves a real-time 3D animation of the simulated aircraft over an existing landscape, which will be implemented by using the Proland software (see Section 5.4).

8. Other Grants and Activities

8.1. European projects

8.1.1. PASSPORT

Participants: Guillaume Bousquet, François Faure, Lenka Jeřábková.

The PASSPORT for Liver Surgery project (http://www.passport-liver.eu/Homepage.html) deals with the objectives of the Virtual Physiological Human ICT-2007.5.3 objective. PASSPORT's aim is to develop patient-specific models of the liver which integrates anatomical, functional, mechanical, appearance, and biological modelling. To these static models, PASSPORT will add dynamics liver deformation modelling and deformation due to breathing, and regeneration modelling providing a patient specific minimal safety standardized FLR. These models, integrated in the Open Source framework SOFA, will culminate in generating the first multi-level and dynamic "Virtual patient-specific liver" allowing not only to accurately predict feasibility, results and the success rate of a surgical intervention, but also to improve surgeons? training via a fully realistic simulator, thus directly impacting upon definitive patient recovery suffering from liver diseases.

Guillaume Bousquet started in September a Ph.D. funded by this project. His purpose is to go beyond Matthieu Nesme's thesis (see Section 6.2.2) for even more robust and efficient patient-specific models for surgery simulation.

8.2. National projects

8.2.1. ANR Masse de données et simulation KAMELEON

Participants: Marie-Paule Cani, Franck Hétroy, Lionel Reveret.

This project started in 2006 and ended on May 2009. It addresses motion capture of small vertebrates. http://www-evasion.imag.fr/people/Lionel.Reveret/kameleon

8.2.2. ANR Masse de données et simulation NatSim

Participants: Antoine Bouthors, Eric Bruneton, Marie-Paule Cani, Philippe Decaudin, Julien Diener, Fabrice Neyret, Jamie Wither, Qizhi Yu.

This project aims at developing new techniques and hybrid representations to model, visualize, animate and transmit natural scenes. It involves EVASION, IRIT and LABRI. EVASION is involved in two workpackages: edition tools in order to "sketch" high level user specification concerning the landscape, and procedural modeling, simulation and real-time rendering of complex scenes (such as terrain, rivers, clouds, trees). The project started on December 22, 2005 and ended on December 21, 2008.

8.2.3. ANR Chênes et roseaux

Participants: Fabrice Neyret, Lionel Reveret.

This project started in 2007 and ends in December 2009. It addresses the modeling and measurement from video of fruit tree resistance to breaking under wind. http://www.ladhyx.polytechnique.fr/public_cr/index.html

8.2.4. ANR Masse de données MADRAS

Participants: Romain Arcila, Franck Hétroy, Lionel Reveret.

This 3-year project, funded by ANR, started on January 1, 2008. Its goal is threefold:

- create a repository of 3D and 3D+t mesh models, together with ground truth segmentations (either done manually or automatically)
- use human perception to enhance conception and evaluation of segmentation algorithms
- develop new segmentation techniques for 3D and 3D+t meshes, using human perception and results of subjective experiments

On this project, EVASION focuses on sequences of meshes evolving through time. Other partners are LIFL in Lille and LIRIS in Lyon.

8.2.5. ANR Vulcain

Participants: Marie Durand, François Faure.

We participate to the ANR Vulcain project (http://vulcain.ujf-grenoble.fr/), which purpose is to evaluate the vulnerability of buildings such as industrial facilities undergoing explosions of projectile impacts. Marie Durand has been hired for one year as an engineer. She will implement discrete element models in GPU in order to speed up concrete fracturing simulations.

8.2.6. ARC Fantastik

Participant: Lionel Reveret.

This project started in 2007 and ended on December 2008. It addresses the development of new methods for parameterization and edition of motion capture data. http://perception.inrialpes.fr/~Arnaud/wwwFantastik/

8.2.7. GdR ISIS Analyse Multirésolution d'objets 3D animés

Participant: Franck Hétroy.

Analyse Multirésolution d'objets 3D animés is a project funded by the GdR ISIS (Groupement de Recherche Information, Signal, Images et ViSion) from CNRS, in which we aim at developing multiresolution analysis techniques for animated 3D objects (e.g. for compression). We work on this project with Cédric Gérot from the GIPSA-Lab in Grenoble, Frédéric Payan from the I3S lab (University of Nice) and Basile Sauvage from the LSIIT lab (University of Strasbourg).

8.3. Regional projects

8.3.1. PPF "Multimodal interaction"

Participants: Adrien Bernhard, Marie-Paule Cani, Adeline Pihuit.

As a team of the LJK laboratory, we participle to the PPF (plan pluri-formation) 'Multimodal interaction' funded by the four universities of Grenoble, with GIPSA-lab, LIG, TIMC, LPNC. This year, collaborated with Renaud Blanch from the IIHM group of the LIG, on the evaluation of the sketching and sculpting systems we developed for creating 3D shapes. See http://www.icp.inpg.fr/PEGASUS/PPF_IM.html#mozTocId325800.

8.3.2. GRAVIT project: GVTR "GeoVisualisation en Temps Réel"

Participants: Eric Bruneton, Fabrice Neyret.

See Section 7.2.

8.3.3. LIMA "Loisirs et Images"

Participants: Eric Bruneton, Marie-Paule Cani, François Faure, Fabrice Neyret, Lionel Reveret.

LIMA (Loisirs et Images) is a Rhône-Alpes project in the ISLE cluster (Informatique, Signal, Logiciel Embarqué). It federates many laboratories of the Rhône-Alpes region (LISTIC, LIRIS, LIS, CLIPS, LIGIV, LTSI, ICA and LJK ARTIS, EVASION, LEAR, MOVI) around two research themes: analysis and classification of multimedia data, and computer graphics and computer vision. The objectives are to index multimedia data with "high level" indexes, and to produce, analyze, animate and visualize very large databases, such as very large natural scenes.

8.4. Mobility grants

Participants: Julien Diener, Adeline Pihuit, Maxime Tournier, Robert Visser, Jamie Wither, Qizhi Yu.

8.4.1. European grants

Jamie Wither, Qizhi Yu got a full European Visitor PhD funding for their PhDs in France (defended in November 2008), while and Robert Visser and Mei Xing got a European Visitor mobility funding to come to our laboratory for a period of 3 or 6 months respectively, including January 2008.

8.4.2. Regional grants

Each year several students get a regional Exploradoc grant to spend several months in another laboratory in another country. This year Julien Diener conducted a joint research project at the DGP lab of the University of Toronto from May 2007 till January 2008. Maxime Tournier and Adeline Pihuit obtained Exploradoc grants to visit respectively Mc Gill University and the University of Montreal at the spring 2009.

8.5. Associate team

Together with the INRIA project BIPOP, we applied to an associate team called SHARE with the University of Vancouver.

9. Dissemination

9.1. Leadership within the international scientific community

Marie-Paule Cani was elected as **Director at large** within the executive committee of ACM SIGGRAPH in June 2008. Nominated fellow of Eurographics in 2005, Marie-Paule Cani was also an elected member the executive committee of the Eurographics association till December 2008, and is a member of the executive committee of the French chapter of Eurographics. She also represented the lab LJK, to which EVASION belongs, in the executive committee of the French computer graphics association (AFIG).

Marie-Paule Cani has been since 2002 a steering committee member of the ACM-EG Symposium on Computer Animation, and was nominated in 2006 steering committee member of the IEEE Shape Modeling & Applications conference. She is also a member of the Eurographics Workshop Board, as a co-chair of the EG working group on Computer Animation. Lastly, she is co-chairing the EG working group on Sketch-Based Interfaces and Modeling.

François Faure has organized the annual Vriphys conference (http://www.vriphys.org).

In 2008, Lionel Reveret has been appointed to the scientific committee of INRIA International Affairs Department.

9.2. Editorial boards and program committees

Editorial boards:
Marie-Paule Cani was member of the editorial board of IEEE Transactions on Visualization and Computer Graphics till April 2008.
Program Committees:

- Marie-Paule Cani was paper co-chair of the Eg workshop Sketch-Based Interfaces & Modeling, held in Annecy in June 2008. She served as a juror in the general submission committee of SIGGRAPH'2008 (selecting everything but papers). She also served in the program committee of Eurographics 2008, and ACM Symposium on Computer Animation 2008.
- François Faure has been a member of the Eurographics International Program Committee.
- Lionel Reveret was a member of the EG08 and SCA08 program committee.

9.3. Invited scientific conferences

François Faure was invited at Zuse Institute Berlin to give a talk called "Fast collision detection and response".

9.4. Large public conferences and meetings

- Marie-Paule Cani has been active for several years in associations promoting parity in sciences, such as the "Association pour la Parité dans les Métiers Scientifiques et Techniques". She gave an invited talk on *Gender and Computer Sciences* at the national conference on women and sciences, organized in Grenoble the 15 of November 2008.
- François Faure gave a talk called "The mathematics of video games" at Lycée de Fernet-Voltaire for the "Ain-Terre Maths" conference.
- Fabrice Neyret participated at various public events:
  - A presentation "The mechanism of scientific publication" at Summer University of Observatoire Zététique (a skeptical organisation) in July.
  - He published 3 articles in a skeptical letter + the magazine "Science et inexpliqué" about bad science in medias ("Sciences et métaphysique, du danger des mélanges; analyse d'une interview de Trinh Xuan Thuan" and "Critique du reporte d'Arte sur 'l'observatoire de Lascaux'").

- A public conference "sciences in special effects and video games" during the "Festival d'un jour" at Valence in March.
- He presented this conference again and an initiation to programming to 4 classes during the "Fete de la Science" at INRIA-Grenoble in November.
- He participated to a "Science-Citizen Café" about "The physics of Star Wars" at Voiron in November.
- He participated with Franck Hétroy to the organization of the 8 yearly pedagogical operation MobiNet for high-school classes during Grenoble INP "semaines decouverte ingénieur".
- He made 2 presentation about MobiNet (software and experiments) to maths teachers during their yearly conference APMEP'08.

9.5. Teaching & Administration

In addition to the regular teaching activities (UJF, Grenoble INP) of the faculty members, several researchers at EVASION taught some courses within the "Computer Science" Research Master, the "Mathematic Engineering" Master and to the 3rd year "Image and Virtual Reality" of ENSIMAG.

Georges-Pierre Bonneau is Director of the Doctorate School of Computer Science, Applied and Pure Mathematics, Grenoble, and head of department "Geometry & Image" in the research laboratory LJK `http://www-ljk.imag.fr`

FranckHétroy is responsible for the "Graphics, Vision and Robotics" branch of the Master of Science in Informatics at Grenoble (MoSIG).

FrançoisFaure is taking the responsibility for the "Image and CAO" branch of the Master of Professional Applied Mathematics at UJF-Grenoble. Like every year, he was invited by the University of Vienna for a two weeks lecture on Computer Animation.

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