Activity Report 2011

Exploratory Action STEEP

Sustainability transition, environment, economy and local policy

RESEARCH CENTER
Grenoble - Rhône-Alpes

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Exploratory Action STEEP

Keywords: Simulation, Natural Environment, Social Environment, LUTI Models, Sustainable Development, Local Policy

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2. Overall Objectives

2.1. overview

STEEP is a new "équipe centre" of INRIA Grenoble - Rhône-Alpes recognized as an INRIA "Action Exploratoire". It has been created in January 2010. STEEP is an interdisciplinary research team devoted to systemic modelling and simulation of the interactions between the environmental, economic and social factors in the context of a transition to sustainability at local (sub-national) scales. Our goal is to develop decision-making tools to support decision makers in the implementation of this transition by developing simulation and optimization programs. In other words, our objective is to set up some mathematical and computational tools which enable us to provide some parts of the answer to the challenges *how to operate the sustainable development at local scales? and which local governance for environmental public policies?*.

2.2. Sustainable development: issues and research opportunities

Sustainable development is often formulated in terms of a required balance between the environmental, economic and social dimensions of the problem, but public policies addressing sustainability are in practice oriented towards environmental issues in Western countries. However, the numerous and interrelated pressures exerted by human activity on the environment make the identification of sustainable development pathways arduous in a context of complex and sometimes conflicting stakeholders and Social-Ecological interactions.

On the one hand urban areas, as focal points of human activity, concentrate most of these pressures in a direct or indirect way. Our civilisation has turned worldwide into an urban one, with more than half the human population living in cities, an ever-increasing trend. Although urbanized areas still represent a very small fraction of the total terrestrial surface, urban resource consumption amounts to three-fourths of the annual total in energy, water, building materials, agricultural products etc, and pollution and waste management is a growing concern for urban planners worldwide. In France, for example, even if resource intensity (materials used divided by GDP) has been reduced by half since the 70s, the material use (total and per inhabitant) has remained essentially constant, and household wastes have grown by 20% since 1995; greenhouse gas emissions have been reduced by a few percent since 1990, but the transportation share (a major issue on this front) has been steadily growing over the same period.

Furthermore, urban sprawl is a ubiquitous phenomenon showing no sign of slackening yet, even in countries where rural depopulation has long been stabilized. Urban sprawl in industrialized countries is largely driven by residential peri-urban growth. The underlying dynamics has proven remarkably stable through a self-sustained positive feedback loop: the creation of suburban housing tracts creates a demand for transportation infrastructures and associated equipments such as parking lots, shopping centers, activity centers, land fills, etc, which in turn favour further suburban sprawl. In 2004, built and associated claimed surfaces amounted to 8% of the French territory. They have grown by 15% from 1994 to 2004 (the equivalent of a French département), and by more than 40% from 1982 to 2004; by comparison, the population growth over the 94-04 decade amounted to only 5%. This phenomenon results in an irreversible loss of cropland; it also induces a fragmentation of ecological habitat, with negative effects on biodiversity, creating a further indirect pressure on agricultural production, with further negative impacts on biodiversity. These trends raise new ethical questions in the global food security degrading context, especially that nearly 50% of agricultural surfaces in France are located in the immediate vicinity of urbanized areas. Controlling urban sprawl in a "climate friendly" framework is a key sustainability issue.

The issues just described require a panel of policy measures at all institutional levels, as they illustrate the existence of both local-local and local-global feedback loops. Nevertheless, the regional (sub-national) and more local levels are of particular importance for the transition to sustainability, especially in a "think global/act local" approach that is up to now mostly oriented towards local climate and energy territorial plans. Indeed, the time left for mitigation instead of adaptation actions is getting shorter by the day, and it is quite obvious that international negociations are making very slow progress if any on all fronts (not only climate change or biodiversity conservation). In this context, more local decision levels have real political and economic leverage, and are more and more proactive on sustainability issues, either individually or in organized nationwide of european-wide networks.

An interdisciplinary team like STEEP, with its strong background in various areas of applied mathematics and modelling, can be a game changer in at least two different but connected research areas : urban development analysis, and related transportation, energy and land use issues ; and urban metabolism analysis and characterization of its (local or distant) environmental impacts. The group potential on these fronts relies on its capacities to strongly improve existing integrated activity/land use/transportation models at the urban level on the one hand, and to build new and comprehensive decision-help tools for sustainability policies at the local and regional levels, in particular through the analysis of strategic social-environmental trade-offs between various policy options.

This theme is new at INRIA, but also for the researchers of STEEP who previously worked in other fields. Elise Arnaud, Emmanuel Prados and Peter Sturm worked on computer vision and Pierre-Yves Longaretti is a

physicist. In particular Peter Sturm has joined STEEP only since May 2011. STEEP staff is still in the process of their own thematic transition and a significant part of their activity is not or only briefly mentioned in this document.

The work of STEEP follows four research directions, that are detailed in the following sections.

3. Scientific Foundations

3.1. Development of numerical systemic models (economy / society / environment) at local scales

The problem we consider is intrinsically interdisciplinary: it draws on social sciences, ecology or science of the planet. The modeling of the considered phenomena must take into account many factors of different nature which interact with varied functional relationships. These heterogeneous dynamics are *a priori* nonlinear and complex: they may have saturation mechanisms, threshold effects, and may be density dependent. The difficulties are compounded by the strong interconnections of the system (presence of important feedback loops) and multi-scale spatial interactions. Environmental and social phenomena are indeed constrained by the geometry of the area in which they occur. Climate and urbanization are typical examples. These spatial processes involve proximity relationships and neighborhoods, like for example, between two adjacent parcels of land, or between several macroscopic levels of a social organization. The multi-scale issues are due to the simultaneous consideration in the modeling of actors of different types and that operate at specific scales (spatial and temporal). For example, to properly address biodiversity issues, the scale at which we must consider the evolution of rurality is probably very different from the one at which we model the biological phenomena.

In this context, to develop flexible integrated systemic models (upgradable, modular, ...) which are efficient, realistic and easy to use (for developers, modelers and end users) is a challenge in itself. What mathematical representations and what computational tools to use? Nowadays many tools are used: for example, cellular automata (e.g. in the LEAM model), agent models (e.g. URBANSIM), system dynamics (e.g. World3), large systems of ordinary equations (e.g. equilibrium models such as TRANUS), and so on. Each of these tools has strengths and weaknesses. Is it necessary to invent other representations? What is the relevant level of modularity? How to get very modular models while keeping them very coherent and easy to calibrate? Is it preferable to use the same modeling tools for the whole system, or can we freely change the representation for each considered subsystem? How to easily and effectively manage different scales? (difficulty appearing in particular during the calibration process). How to get models which automatically adapt to the granularity of the data and which are always numerically stable? (this has also a direct link with the calibration processes and the propagation of uncertainties). How to develop models that can be calibrated with reasonable efforts, consistent with the (human and material) resources of the agencies and consulting firms that use them?

3.2. Calibration and convergence of integrated models

When implementing such integrated models, one of the main difficulties lies in the calibration process. Feedback from past experience tend to show that this task is very difficult to proceed, and needs an important experimental expertise. In practice, the equilibrium models such as Tranus converge with difficulty, and the current algorithms do not enable to easily correct the parameters to obtain the convergence. This convergence is a key-point of the calibration: the goal is to be able to reproduce a reference state in a stable manner.

Calibrating such models involve the estimation of a large number of parameters, that are difficult to estimate from the data. In general, and this is true for the case of Tranus, these parameters are currently adjusted by hand, through a long process of trials / errors. The calibration can typically take up to 6 months for a medium size model (about 100 geographic zones, about 10 sectors including economic sectors, population categories, employment categories). So far, ways to optimize these parameters in an automatic or semi-automatic manner do not exist, and it is not possible to guide the solution towards a good representation of the observed reality,

but by hand. Here, it is not only to converge towards a stable state that matters, but also to make sure that this state corresponds to the chosen reference of the urban system we aim at mimicking.This is of course a crucial condition to ensure the prospective results produced afterwards by the models to be relevant.

Finally, let us note that knowledge of uncertainties has to to be taken into account in the calibration process to obtain robust and reliable results. This is detailed in the following section.

3.3. Consideration and management of uncertainties in integrated models

Uncertainty arises at different levels; it ranges from imprecisions and inaccuracies in data until the absence of scientific knowledge on certain processes under consideration. Until now, this range of difficulties has practically not been fully taken into account in our target domain of integrated socio-economic and environmental models. Taking into account uncertainties is crucial in our opinion, for various reasons. First, it is essential to understand the propagation of errors and its impact on final obtained results. In this respect, it is necessary to carry out a deep analysis of sources of error/uncertainty and of the sensitivity of different model variables or indicators [1] relative to errors in the input data and the estimated parameters. This analysis should allow to ensure that the output variables' values or the indicators are meaningful with respect to uncertainties present. In other words, the objective is to guarantee the robustness of conclusions drawn by analysts [2]. To our knowledge, existing modeling works are, besides a few exceptions, limited to providing deterministic results without an evaluation of the confidence in these results.

Let us remind here that it is important to distinguish at least two error sources, which together impact results. First, errors in input data, whose influence on the final results is due to structural aspects of a model, related to stability and robustness. Second, errors introduced by the model itself, due to the model being only an approximation of reality. An analysis of the latter is as crucial as one of the former and touches upon the problem of model validation. The literature on this is extremely scarce; only few works propose ideas and elements of actual methodologies.

While a sensitivity analysis allows to assess if it is possible to draw significant conclusions based on an implemented model, such an analysis also enables to determine the main "drivers" of the model: the parameters that have a strong impact on the model's dynamics. The identification of these "drivers" is of utmost importance for decision makers, in their search for leveraging solutions.

Sensitivity analyses are also very useful, e.g. in order to gain insight into the level of precision in input data and parameters that would guarantee a model's validity. Such prior knowledge is important for the technician who has to set up a model in practice. It allows to not waste energy in the production of ultra-precise data that eventually would not have a great impact. Reciprocally, such knowledge enables the concentration of efforts on sensitive data. Finally, as mentioned previously, sensitivity analyses constitute precious tools allowing to reduce the number of parameters to be optimized during the model's calibration phase (by only keeping parameters with strong impact).

Independently of all this, it is worthwhile and indeed essential to take into account uncertainties on data already at the calibration stage. We propose to do so in a similar fashion to what is done in data assimilation. By encapsulating the above errors in the calibration algorithm itself, one may limit their propagation. Likewise, it is important to automatically detect and possibly to correct wrong data during the calibration process. Finally, it is mandatory to consider a specificity of socio-economic and environmental models such as those considered by our team, namely the importance (unavoidability) of *scenarios*. In some cases, these scenarios concern control aspects (in the mathematical sense of control theory) or very large uncertainties. For instance, it is usual to use scenarios corresponding to different political decisions whose impact one is to assess; such scenarios concern control aspects. Also, in the present time, climatic scenarios are considered quasi-systematically; those scenarios refer rather to uncertainties. Let us stress the fact that this type of important uncertainties lacks in physical and geophysical models. It is quite specific to socio-economic models and, to our knowledge, has

[1] An indicator is a piece of information computed *a posteriori* from the model's output variables. This information may be more or less quantitative. It can be represented by numbers but may also take the form of tendencies ...

[2] ...who use output variables and indicators as building blocks for their own analysis.

not been formally studied yet. This type of uncertainties can not be handled in the same way as "noise" in input data or errors due to approximations done by a model. Still, any sensitivity analysis of data and parameters, as well as calibration methods, ought to be robust to these uncertainties, which is why we plan to work on these aspects.

3.4. Environmental impacts of urban policies

One of the major issues in sustainbaility policy at the local/regional scales relates to the use of resources generated by the activity present on the considered territory, in particular in urban areas, considering their direct dependence on vast and sometimes distant territories and resources. In particular, quantifying the nature of local or distant impacts related to this activity is a major challenge both in terms of used resources and emitted pollutants.

To address this issue, one needs to correctly assess all flows, production and consumption of matter and energy on the territoriy. Without a sufficiently detailed characterization of the use of matter/energy, not only by type but also by origin and destination, the associated impacts cannot be correctly grasped by stakeholders and decision makers. This question is critical in a context where a factor of 4 of reduction of *both* energy and material use is advocated by various institutional agencies (e.g., the European Environmental Agency). Furthermore, in order to develop environmental policies (in particular urban policy) that do not result in a transfer of problems, either from one resource to another or from one territory to another, one needs to be able to assess policy options not only in terms of trade-off between societal issues (bearing, e.g., on activity location and transport needs) but more broadly by including also society-environment or environment-environment trade-offs (bearing, e.g., on greenhouse gas emission abatement policies and their potential indirect impacts on other environmental issues such as land and water use).

Such a description of the “metabolism" of a territory is made difficult by the structure of presently available statistics, either at the national or at more local scales. Indeed, such statistical tools focus much more on monetary than material and physical aspects, a bias that is easily understood as these tools were created in a context of (still) virtually infinite natural resources. This type of research requires to collect data from a large variety of sources (e.g., transportation ministry, INSEE, Agriculture Ministry, various professionnal organizations...) and to adapt methodologies of material flow analysis and associated impact characterization, that already exist at the national or european level, to more local administrative and geographic units.

Without incorporating this type of impact assessment, the policy decision-help provided by intergrated urban models described above miss their main objective of characterization of urban planning policies in terms of sustainability issues. In this respect, developing multi-criteria decision-help tools drawing on both types of analyses (integrated urban modelling and integrated urban environmental impact assessment) is an important long-term objective of the STEEP team.

4. Software

4.1. TEOS: Tranus Exploration and Optimization Software

Participants: Anthony Tschirhard, Mathieu Vadon, Elise Arnaud, Emmanuel Prados.

The TEOS software offers a set of tools to help the calibration of the land use and transport integrated model TRANUS. It uses some exploration and optimization procedures of the relevant parameters.

5. New Results

5.1. Definition of the research priorities, and first works

As STEEP addresses pluri-disciplinary research topics that are new both for INRIA and for the STEEP members, our very first goal of this year has been to define and specify the four research priorities described above: (a) development of numerical systemic models (economy / society / environment) at local scales; (b) calibration and convergence of integrated models; (c) consideration and management of uncertainties in integrated models; (d) environmental impacts of urban policies.

To gain better insight into these issues, we choose to start with the TRANUS model, as first experimental framework. We collaborate closely with IDDRI (Institut du Développement Durable et des Relations Internationales, Paris http://www.iddri.org/), that has implemented a TRANUS model applied to the city of Grenoble in the context of the AETIC project. We make use of this model as starting point to investigate the three first topics.

(a) We have started a project consisting in designing and implementing an integrated model by ourselves, in close collaboration with the EDDEN laboratory (laboratoire d'Economie du Développement Durable et de l'Energie, Grenoble http://webu2.upmf-grenoble.fr/LEPII/spip/spip.php?article22) and IDDRI. The goal in to enrich the transport / land use Grenoble model with energy sectors, using the data and analysis our partners are generating in the context of the AETIC project. The goal here is to find a way to encapsulate in or combine the energy models proposed by EDDEN with the TRANUS model implemented by IDDRI for Grenoble.

(b) We participated to the still on-going calibration procedure of the Grenoble models, which is leaded by IDDRI and Modelistica. This helped us to identify the keypoints of the calibration of such a model, and to propose first semi-automatic approaches based on simple parameters optimizations.

(c) We started an uncertainty analysis of this model.

Parallel to that, we have taken an interest in the LEAM model and URBANSIM and we are preparing an ANR project on TRANUS and URBANSIM which would allow us to deeply compare the very different representations on which they are based on.

5.2. Building of Partnerships

This year, we have spent a considerable amount of time and energy to build various partnerships.

We have started a collaboration with Modelistica and Tómas de la Barra, the author of TRANUS Model. Tómas de la Barra came at INRIA for a week in June 2011. We have submitted a project to ECOS-Nord program (TRACER). Among others, we are closely working with him on TRANUS calibration.

Our collaboration with EDDEN is now fully set up. We are working with them on the design of a transport-land use-energy integrated model for the city of Grenoble using the data and analysis they are generating in the context of the AETIC project. This work is based on the TRANUS model implemented by IDDRI for Grenoble. In the same way, our collaboration with IDDRI has started to be effective. With IDDRI, we work on TRANUS calibration issues and practically on the Grenoble model they are implementing. IDDRI is the coordinator of TRACER project submitted to ECOS-Nord program.

In other respects, with AURG (Agence d'Urbanisme de la Région Grenobloise http://www.aurg.org/) and EDDEN, we are one of the driving forces behind the MUTERA project. This project aims at gathering the main actors in urban planning and transport of the Rhône-Alpes region to work on the issues regarding land-use and transport models. This group includes technicians, politicians and researchers. The kick-off meeting should take place in the beginning of 2012.

We have also started a collaboration with the LECA laboratory (Laboratoire d'Ecologie Alpine, Grenoble http://www-leca.ujf-grenoble.fr/). In June 2011, we have submitted a project to FRB Flagship program with them (ESNET).

In parallel of that, we got in touch with a number a potential partners and colleagues ones of which are the LET laboratory (Laboratoire d'Economie des Transport, Lyon http://www.let.fr/), the department of urban and regional planning of the university of Illinois at Urbana-Champaign (visit to Brian Deal), Veolia Environnement, SOGREAT *etc*. A number of them have been contacted in the framework of the development of an ANR project which should be submitted to 2012 "Modèles numériques" program or in the framework of CIFRE or industrial partnerships.

5.3. First results on material flow, production and consumption analysis

This theme of research has been started this year through a 6 month internship with a student of Ecole Centrale de Lyon. A large database has been constructed, that allows to analyze material flows, production and consumption by type (and origin and destination in case of flows) at the level of the French region and departments. This database compiles data from a variety of public institutions and private organizations. Almost all the data are in the public domain. A large amount of work has gone into building the database, normalizing the different data sources at least in terms of classification, and into building tools to manipulate the data and produce usable information.

At present, this “physical accounting" has been performed on all French regions for a limited number of materials (in particular cereals, fossil fuels, and construction materials). Furthermore, it has been performed for the same materials at the departement level in the Rhone-Alpes region.

This work is now focusing on various issues:

- By correlating the relevant quantities with other variables (such as, e.g., population or land use, etc), it is possible to downscale the consumption and waste production data at the level of urban regions (where a large part of this information is unavailable). Such an information is critical for the development of decision-help tools at the level of urban areas.
- A process of quantification of the major source of information on material transports is the SitraM database (transportation database maintained by the Ministry of Ecology and Sustainable Development). These data are statistical in nature, but the statistical error is unknown. We are in the process of developping a way to estimate this error.
- The next step will then be to transform this material use in terms of environmental impact. Various types of impacts (global and local) have been identified. The quantification will rely on various known approaches (Life Cycle Analysis, regional Input-Analysis), notably drawing on part of the work performed in this area by the Global Footprint Network (even for impacts that cannot be quantified in terms of land, carbon or water footprint).

6. Contracts and Grants with Industry

6.1. Contracts with Industry

Contract with EADS Astrium, full funding of PhD thesis of Régis Perrier (2007–11).

7. Partnerships and Cooperations

7.1. Regional Initiatives

Project acronym: MUTERA

Project title: Modèles Urbanisme-Transport-Environnement en Rhône-Alpes

Starting date: 2012

Coordinator: Emmanuel Raoult (AURG)

Other potential partners: IAU-IDF, LET, IDDRI, INRIA, EDDEN, AURG, SMTC, Urba Lyon, Sytral, La Métro, etc.

Abstract: The rich and diverse activity in modeling in Rhône-Alpes region, the need of more technical expertise of the various actors and the necessity for decision makers to be able to project into an uncertain future via innovative tools developed by the research are three elements that push the creation the MUTERA project. MUTERA aims then to gather the main actors in urban planning and transport of Rhône-Alpes region to work on the issues regarding land-use and transport models. This group includes technicians, politicians and researchers. MUTERA kick-off meeting is foresaw in the beginning of 2012.

Project acronym: SOCLE3

Project title: Sustainability, Local Collective Organisation, Energy, Economy and Environment

Coordinator: Pierre-Yves Longaretti (STEEP)

Other partners: LECA (UJF/CNRS), EDDEN (UPMF/CNRS), PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)

The SOCLE3 interdisciplinary group and project has two major aims:

- Analyzing and modelling the environmental, economic and social interactions at the urban to regional (sub-national) level, and their coupled trajectories under given global and local macroeconomic trends, and climate change constraints.
- Providing decision-makers with policy analysis and evaluation tools, and other researchers with methodological tools, based in particular (but not exclusively) on simulations under relevant global/local scenarios, to identify and characterize possible sustainability transition pathways at the local and regional scales.
- http://socle3.obs.ujf-grenoble.fr/

7.2. National Initiatives

Program: "Modelling and Scenarios of Biodiversity" flagship program, Fondation pour la Recherche sur la Biodiversité

Project acronym: ESNET (submitted)

Project title: Ecosystem services networks futures for the Grenoble region

Duration: 2012 - 2014

Coordinator: Sandra Lavorel (LECA)

Other partners: LECA (UJF/CNRS), STEEP(INRIA/LJK) , EDDEN (UPMF/CNRS), CEMAGREF Grenoble, PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)

Abstract: Ecosystem services are underpinned by fundamental ecological properties and processes interacting with society, both through human dependence on these services, and the use and management of ecosystems. Our hypothesis is that ecosystem services can thus be modelled as networks of interacting ecological and societal processes, at multiple spatial and temporal scales. Our interdisciplinary research team proposes to explore this network hypothesis by assessing alternative futures of ecosystem services under combined scenarios of land-use and climate change for the Grenoble urban area in the French Alps. We will capitalize on existing statistical and mechanistic methods to build and integrate models of the relevant ecosystem services and land-use change. Our assessment will benefit from our detailed understanding of how biodiversity and different ecosystem services are interconnected. Trade-offs and synergies will be quantified by a specifically designed spatial multi-criteria analysis. Besides the urban area, we will focus on two case study sub-systems: the intensively farmed valley upstream of the city and a mixed landscape of forests and grasslands in a mountain range south of the city. As beneficiaries of ecosystem services, local and regional stakeholders will be involved in formulating the project working hypotheses and scenarios. These scenarios will build on current urban planning exercises by public authorities and research teams, and downscaling of land-use and climate change projections. We will engage stakeholders in the comparison of scenarios and the assessment of trade-offs in order to foster a dialog on development pathways and mitigation options.

In other respects, we are also strongly connected to the AETIC project. Initially we were not members of this project. But we follow it very closely and we already build on it via our collaboration with EDDEN laboratory and IDDRI. In particular our project of modeling and implementing transport-land use-energy integrated model for the city of Grenoble uses the data and analysis which are generating in the context of AETIC project.

Program: ANR project (Ville durable)

Project acronym: AETIC

Project title: Approche Economique Territoriale Intégrée pour le Climat

Duration: 2010 - 2013

Coordinator: Patrick Criqui (EDDEN)

Partners: UMR EDDEN, company ENERDATA Conseil, VEOLIA Environnement, CSTB (Centre Scientifique et Technique du Bâtiment), IDDRI (Sciences Politiques Paris), UMR PACTE.

Abstract: AETIC project aims to achieve three objectives: 1) to provide economic tools which allow to calculate and integrate costs and quantities useful for the territorial climate policy (PCL–"*Plan Climat Local*"). 2) to provide an analysis of the PCL of Grenoble metropolitan area. 3) to define a consistent and innovative methodology for the definition of the PCL.

A project related to previous activities in computer vision of project members:

Program: ANR CONTINT

Project acronym: ROM

Project title: Realtime Onset Matchmoving

Duration: 2008 – 2011

Coordinator: Duran Duboi SA

Other partners: VORTEX (IRI Toulouse, France)

Abstract: This industrial R&D project concerns the generation of special effects for movie or other film productions. In particular, the goal is to provide tools for successful onset matchmoving, that is the estimation of camera trajectories during acquisition, with immediate pre-visualization of special effects superimposed on acquired sequences. Besides this real-time aspect of matchmoving, the project also addresses the problem of preparing a shooting, by analyzing if matchmoving with natural features is possible and if not, by instrumenting the scene with artificial markers in appropriate positions.

7.3. European Initiatives

A project related to previous activities in computer vision of project members:

Program: ESA ITI (European Space Agency Triangular Initiatives)

Project acronym: ITI 3D

Project title: Multi-View 3D Reconstruction of Asteroids

Duration: 2010 – 2011

Coordinator: EADS Astrium

Abstract: The goal of the project is to implement and validate algorithms for image-based 3D modeling of asteroids. The algorithms combine multi-view stereo and shape-from-shading.

7.4. International Initiatives

7.4.1. INRIA International Partners

We collaborate closely with Tomàs De La Barra (Modelistica company, Professor at Facultad de Arquitectura y Urbanismo (Venezuela)). Tomàs De La Barra is the foundator of the Land-Use and Transport Integrated Model Tranus. In the framework of this collaboration, Tomàs visited us for one week to advance the calibration of Tranus on Grenoble, and an ECOS NORD project has been submitted.

7.4.2. Visits of International Scientists

7.4.2.1. Post-docs

Juho Kannala (2 months, Nov/Dec 2011)

Institution: University of Oulu and National Academy of Finland

7.4.2.2. Internships

Mariano Luis Fernandez (from Apr 2011 until Sep 2011)

Subject: Re-implementation of a land use / transport model

Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Luis Manterola (from Jun 2011 until Nov 2011)

Subject: Adaptation of the land use part of TRANUS model to the OPUS framework

Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Alejandro Deymonnaz (from Jul 2011 until Dec 2011)

Subject: Shape From Ambient Shading

Institution: Universidad de Buenos Aires (Argentina)

7.4.3. Participation In International Programs

Program: ECOS NORD Venezuela

Project acronym: TRACER (submitted)

Project title: TRanus, Analyse de la Calibration et des Erreurs, Retours sur Grenoble et Caracas

Duration: 2012 - 2015

Coordinator: Laurence Tubiana (IDDRI), Tomàs de le Barra (Facultad de Arquitectura y Urbanismo, Venezuela)

Other partners: IDDRI, STEEP, Facultad de Arquitectura y Urbanismo (Venezuela)

Abstract: Having quantified elements on urban dynamics is necessary if one wants to implement policies that are coherent with sustainable urban objectives. Land use and transport integrated (LUTI) models enable such a quantification. Their use has successfully increased in the framework of urban prospect where environmental issues are preponderant. A large dissemination of such tools in the local authority agencies is nowadays crucial to evaluate urban policies, yet limited by various difficulties, such as lack of robustness and calibration issues. The objective of this project is to bring answers to these limitations. We choose to focus on the Tranus model, one of the most used LUTI model. Our work will be organized in three research directions. First, we aim at analyzing how Tranus is used by local agencies. Then, a comparison between the Tranus implementation and use for the cities of Grenoble (France) and Caracas (Venezuela) is planned. And finally semi-automatic calibration tools will be developed, and an uncertainty and sensitivity analysis will be performed.

8. Dissemination

8.1. Animation of the scientific community

8.1.1. Editorial activities and reviewing

Peter Sturm is associate editor of the journals IVC, JMIV, JCST, and CVA.

Peter Sturm was Area Chair of CVPR'11 and program committee member of 4 international workshops.

8.1.2. Conference organization

Peter Sturm has been Program Chair of the IEEE International Conference on Computer Vision (ICCV'11), Barcelona, Spain.

Amaël Delaunoy, Frédéric Devernay (PRIMA), Régis Perrier, and Peter Sturm have organized the "Congrès des jeunes chercheurs en vision par ordinateur" (ORASIS'11), Praz-sur-Arly, France.

Peter Sturm is Program Chair of the "Congrès de Reconnaissance des Formes et Intelligence Artificielle" (RFIA'12), Lyon, France.

8.1.3. Membership of scientific councils and similar bodies

Emmanuel Prados is a member of the Steering Committee of the FRB (Fondation pour la Recherche sur la Biodiversité) program "Modelling and scenarios for the biodiversity" since June 2010.

Peter Sturm is a member of the INRIA COST-GTAI (national working group on "actions incitatives") since 2005.

Peter Sturm is a member of the Scientific Committee (COS) of INRIA Grenoble, since 2011.

Peter Sturm is a member of the Scientific Council of Barcelona Media (Spain), since 2010.

Peter Sturm was leader of the geometric computer vision task group of the national network GdR ISIS (with Adrien Bartoli, Université d'Auvergne), 2006-2011.

8.2. Participation to conferences, seminars

Emmanuel Prados has been invited for a seminar at the "Deterministic Models and Algorithms Department" of Jean Kuntzmann Laboratory. Title of the talk: "Systemic modelling of the interactions between environment, economy and society at local scales: problems and bottlenecks.", Grenoble, France, April 19th, 2011. Organizer: Nicolas Papadakis.

Pierre-Yves Longaretti gave a talk on "Urban and periurban sustainability at regional scales at the 2020 and 2050 horizons" at the Colloque "PIRVE" (Programme de Recherche Interdisciplinaire Ville et Environnement), Nantes, May 5th-6th, 2011.

Peter Sturm gave a keynote speech on "A historical survey of geometric computer vision" at the 14th International Conference on Analysis of Images and Patterns (CAIP'11), Seville, Spain, September 2011.

Peter Sturm gave a keynote speech on "A historical survey of geometric computer vision" at the 11th Workshop on Omnidirectional Vision and Camera Networks (OMNIVIS'11), Barcelona, Spain, November 2011.

Pierre-Yves Longaretti gave an invited seminar at the Department of Regional and Urban Planning of the University of Urbana-Champaign, Illinois, US. Title of the talk: "Why we are on a global collapse path and what we can do about it". Urbana-Champaign, April 14th, 2011. Organizer: Brian Deal (head of the department).

8.3. Teaching

Licence: Introduction to applied math, 14h, L1, UJF, E. Arnaud

Master: image project, 22h, M1, UJF, E. Arnaud

Master: Introduction to image analysis, 8h, M1, UJF, E. Arnaud

Master: Multimedia indexing, 24h, M2, UJF, E. Arnaud

Master: Knowledge representation and reasoning, 14h, M2, UJF, E. Arnaud

Master: Supervising of apprentices, 30h, M2, E. Arnaud

Master: Visual computing, 30h, M2, P. Sturm

Master: Computer Vision, 30h, M2, P. Sturm

Master: 3D Computer Vision, 6h, M2, P. Sturm

8.4. PhD

PhD : Amaël Delaunoy, *Multi-view Shape Reconstruction from Images : Contributions Towards Generic and Practical Solutions using Deformable Meshes*, University of Grenoble, December 2nd, 2011, advised by Peter Sturm and Emmanuel Prados

PhD : Mauricio Diaz, *Analyse de l'Illumination et des Propriétés de Reflectance en Utilisant des Collections d'Images*, University of Grenoble, October 2006, 2011, advised by Peter Sturm

PhD : Régis Perrier, *Estimation de l'attitude d'un satellite à l'aide de caméras pushbroom et de capteurs stellaires*, University of Grenoble, September 27th, 2011, advised by Peter Sturm and Elise Arnaud

PhD in progress : Mathieu Vadon, *Semiautomatic calibration of the land use module of Tranus*, since October 2010, University of Grenoble, advised by Emmanuel Prados and Elise Arnaud.

PhD in progress : Julien Alapetite, since 2009, University of Grenoble, advised by Denis Dupré (CERAG) and Pierre-Yves Longaretti.

PhD in progress : Ashutosh Natraj, since 2009, University of Picardie Jules Verne, advised by Pascal Vasseur, Cédric Démonceaux, and Peter Sturm.

9. Bibliography

Publications of the year

Doctoral Dissertations and Habilitation Theses

[1] A. DELAUNOY. *Multi-view Shape Reconstruction from Images : Contributions Towards Generic and Practical Solutions using Deformable Meshes*, Université de Grenoble, December 2011.

[2] M. DÍAZ. *Analyse de l'Illumination et des Propriétés de Reflectance en Utilisant des Collections d'Images*, Université de Grenoble, October 2011, http://tel.archives-ouvertes.fr/tel-00641467/en/.

[3] R. PERRIER. *Estimation de l'attitude d'un satellite à l'aide de caméras pushbroom et de capteurs stellaires*, Université de Grenoble, September 2011, http://tel.archives-ouvertes.fr/tel-00637592/en/.

Articles in International Peer-Reviewed Journal

[4] A. DELAUNOY, E. PRADOS. *Gradient Flows for Optimizing Triangular Mesh-based Surfaces: Applications to 3D Reconstruction Problems dealing with Visibility*, in "International Journal of Computer Vision", 2011.

[5] J. DRARÉNI, S. ROY, P. STURM. *Plane-Based Calibration for Linear Cameras*, in "International Journal of Computer Vision", 2011, vol. 91, n^{o} 2, p. 146–156.

[6] L. PUIG, Y. BASTANLAR, P. STURM, J. GUERRERO, J. BARRETO. *Calibration of Central Catadioptric Cameras Using a DLT-Like Approach*, in "International Journal of Computer Vision", 2011, vol. 93, n^{o} 1, p. 101–115.

[7] P. STURM, S. RAMALINGAM, J.-P. TARDIF, S. GASPARINI, J. BARRETO. *Camera Models and Fundamental Concepts Used in Geometric Computer Vision*, in "Foundations and Trends in Computer Graphics and Vision", 2011, vol. 6, n^{o} 1–2, p. 1–183.

International Conferences with Proceedings

[8] M. DÍAZ, P. STURM. *Exploiting Image Collections for Recovering Photometric Properties*, in "Proceedings of the 14th International Conference on Computer Analysis of Images and Patterns", Seville, Spain, Springer-Verlag, 2011, p. 253–260.

[9] M. DÍAZ, P. STURM. *Radiometric Calibration using Photo Collections*, in "Proceeding of the ieee International Conference on Computational Photography, Pittsburgh, USA", 2011.

[10] V. R. KOMPELLA, P. STURM. *Detection and Avoidance of Semi-Transparent Obstacles using a Collective-Reward Based Approach*, in "Proceedings of the ieee International Conference on Robotics and Automation", Shanghai, China, 2011.

[11] S. RAMALINGAM, S. BOUAZIZ, P. STURM. *Pose estimation using both Points and Lines for Geo-Localization*, in "Proceedings of the ieee International Conference on Robotics and Automation", Shanghai, China.

[12] S. RAMALINGAM, S. BOUAZIZ, P. STURM, P. TORR. *The Light-Path Less Traveled*, in "Proceedings of the Conference on Computer Vision and Pattern Recognition", Colorado Springs, USA, 2011.

[13] P. STURM. *A Historical Survey of Geometric Computer Vision*, in "Proceedings of the 14th International Conference on Computer Analysis of Images and Patterns", Seville, Spain, Springer-Verlag, 2011, p. 1–8.

National Conferences with Proceeding

[14] L. CALVET, P. GURDJOS, V. CHARVILLAT, S. GASPARINI, P. STURM. *Suivi de caméra à partir de marqueurs plans composés de cercles concentriques : paradigme et algorithmes*, in "Journées ORASIS 2011", Praz-sur-Arly, France, 2011.

[15] M. DÍAZ, P. STURM. *Calibrage radiométrique en utilisant des collections de photos*, in "Journées ORASIS 2011", Praz-sur-Arly, France, 2011.

Scientific Books (or Scientific Book chapters)

[16] F. CAMILLI, E. PRADOS. *Viscosity Solution*, in "the Encyclopedia of Computer Vision", K. IKEUCHI (editor), Springer, 2011, http://hal.inria.fr/inria-00546110/en.

Research Reports

[17] E. PRADOS, N. JINDAL, S. SOATTO. *A non-local approach to shape from ambient shading*, INRIA, November 2011, n^{O} RR-7783, http://hal.inria.fr/inria-00637531/en.