Implementation of a gradient based calibration algorithm for a land-use and transport model

- Inria research team: STEEP
- Website of the Inria research team: http://steep.inrialpes.fr

- Internship supervisor: E. Prados, P. Sturm
- Supervisor's email address: Peter.Sturm@inria.fr
- Internship location (Inria's research centre): Grenoble
- Level of education of the candidate: Engineer
- Duration (in months): 6 -- Start date: 04/2013 -- End date: 10/2013  (dates are quite flexible!)

Keywords:
- Optimization algorithm programming
- Parameter estimation, calibration of simulation models.
- Socio-economic models for sustainable development. Models for the location of activity (households, jobs, industries, etc.). Interactions between transport and location of the economic activity: Land Use and Transport interaction modeling (LUTI).

Possibility to pursue for a PhD position:

This internship can eventually lead to a PhD position; STEEP lab has already funds for several PhD positions starting in autumn 2013 on that topic. This funding is associated to the project “CITiES” which gathers modelers, urban planners, mathematicians and computer scientists.

Context:

STEEP studies the mathematical models describing the interactions between social and economic activities and environment. In context, STEEP studies in particular the evolution of the land use and its interactions transport system at local scale such as urban areas: where economic activities are located, including the location of housing, for example. Although the land use and transport influence each other, this relationship is often not enough taken into account in the urban planning. One of the consequences is the current difficulty to compare the different scenarios alternative for the development of a city (for example, creating a new line of a tram or a new high way, inciting isolation of part of the housing...).

In order to contribute to sustainable development, our team is trying to make applicable the mathematical models of socio-economic activities developed by research in economy and the other social sciences. This requires the development of numerical methods which allow to apply these models on specific and real urban regions, by using the data available for those regions (for example, the prices of the real-estate in the different zones, demography, incomes...).

Objectives of the internship:

The main aim of the internship is to design, develop and validate a method of calibration of a Land-Use and Transport Integrated model (LUTI). The considered model here is TRANUS; this is one of the LUTI models the most widely used in the world. The model is based on non-linear equations modelling the relations between the economic activities, prices, transport, etc. To apply this model to
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the specific data of the considered urban region, we have to evaluate some of its parameters by numerical optimization.

Various gradient descent based calibration algorithms have been implemented in our group by using discrete optimization libraries of Matlab. The goal of this internship is to compute now the exact gradient (much more accurate and efficient than to use discrete gradients) associated to our model and to implement this in Python, FORTRAN or C++. The implementation of various I/O interfaces will be also required.

The internship will have theoretical aspects (design and analysis of a method of calibration) and practical ones (implementation and tests). The method developed will be tested on a model of Grenoble urban region.

Advisors:
- Emmanuel Prados (Head of STEEP Lab.). Exceptionally no contactable in December 2012. Please contact Peter Sturm.
- Peter Sturm: http://perception.Inrialpes.Fr/~Sturm/, peter.Sturm@inria.fr, (+33) 4 56 527 133

Internship location:

This position is offered at the “Rhône-Alpes” Research Unit of INRIA, located near Grenoble. It takes place in the STEEP team (Sustainability, Transition, Environment, Economy and local Policy). STEEP is an interdisciplinary research team that tries to model regional transition to sustainability and develops mathematical and computational tools for decision-making. This group gathers physicists, modelers, geographers/planners, mathematicians and computer scientists. This work will be done in close collaboration with MOISE INRIA team.

Skills required:
- Strong knowledge of programming (C++, Python or FORTRAN).
- Knowledge of numerical optimization.
- An interest in sustainable development would be a plus.

Application:
- For international students: Please APPLY ONLINE via: http://www.inria.fr/recherches/mobilite-internationale/programme-internships/candidatures AND SENT a complete CV, a cover letter and a list of two references (telephone numbers and email address) to Peter Sturm as soon as possible.
- For French students: To apply, please send a pdf file containing a complete CV (eventually your publication list), a cover letter and a list of two references (with telephone numbers and postal and e-mail addresses) to Peter Sturm before the 7th of December 2012.

Deadline: 7th of December, 2012