Postdoctoral fellow in mathematical ecology

The landscape language: a formal grammar developed and implemented for landscape modelling.

Join an exciting team on a unique new project investigating landscape dynamics and ecological modelling, based in Montpellier, South of France. We are seeking enthusiastic candidates for a one-year postdoctoral position studying landscape modelling using formal language.

Supervisor: Cédric GAUCHEREL (INRA - EFPA, UMR AMAP, Montpellier)

Context

Patchy landscapes driven by human decisions and/or natural forces are still a challenge to be understood and to be modelled. Attempts to define a coherent framework such as a mathematical description to derive landscape evolution rules are still very scarce. This is the first objective of this postdoctoral position. We propose to develop a new formalism of landscape modelling based on rewriting rules belonging to the widest field of formal grammars (Chomsky 1956). Patchy landscape units (patches) indeed may be handled by a set of driving forces that are gradually changing their states according to human decisions (e.g. agricultural of forestry politics) or natural forcing (e.g. climate). We wish to adapt formal grammar approaches to such specific two-dimensional mosaics. Do have landscapes a common language? Which syntax would be the most appropriate for rural landscapes? This work is based on the hypothesis that landscapes have common features and dynamics that an adapted language may capture. Such a language and stochastic rules should then be used for landscape modelling and would greatly improve our understanding of landscape dynamics.

The second objective of this work is to implement such grammar (reusing for instance existing Relational Growth Grammar package such as *GroImp* (Kniemeyer et al. 2008)), into an existing landscape modelling platform prototype written in Java® and called DYPAL (*Dynamic PAtchy Landscape*). First, this task supposes to develop a computing bridge between the grammar editorial software and the existing prototype. This will require to modify the existing platform kernel (based on landscape objects and spatio-temporal operations (Gaucherel et al. 2006)) to make it compatible with grammar rules. Finally, some well-chosen case-studies will be implemented to illustrate new features of the system based on various evolution scenarios with different impacts on landscape patterns. The development of the platform will be performed in narrow collaborations with agriculture and forestry specialists, providing site data as well as detailed expertise about their studied landscapes. Powerful landscape formalism as well as a user-friendly modelling platform would emphasize the interest of formal grammar approaches to model patchy landscapes, and hopefully other landscape structures.

Materials

BiodivAgriM project data at landscape scales (this ~1 M€ project of the ANR – Biodiversity call started in 2007 and is exploring landscape modelling in order to preserve biodiversity in rural landscapes).

Searched skills

Qualifications: A PhD doctorate in either applied mathematics and computing with some biology/ecology skills or in biology/ecology with strong mathematical skills would be appreciated. The candidate should demonstrate interest in the broader questions in ecology and complexity theory studies and a strong motivation. Research experience in landscape ecology, in theoretical ecology, in stochastic processes and analytical/numerical modelling are desirable.

Employment Conditions: Initial appointment would be for a period of one year, according to the INRA postdoctorat salary (~ 25 k€ brut / yr). The starting date is negotiable between January and March 1st, 2010. The postdoctorat may be transformed into a more classical contract if necessary.

To Apply: Please send a single PDF file containing letter of application with statement of interest, CV and two letters of reference to Cédric Gaucherel (*gaucherel at cirad.fr*). For full consideration, apply by March 1st, 2010.

References

ACL1.   Chomsky, N. 1956. Three Models for the Description of Language. IRE Transactions on Information Theory 2:113–124.

ACL2.   Gaucherel, C., N. Giboire, V. Viaud, T. Houet, J. Baudry, and F. Burel. 2006. A domain specific language for patchy landscape modelling: the brittany agricultural mosaic as a case study. Ecological Modelling 194:233-243.

ACL3.   Kniemeyer, O., G. Barczik, R. Hemmerling, and W. Kurth. 2008. Relational Growth Grammars - a parallel graph transformation approach with applications in biology and architecture. Pages 152-167 *in* A. Schürr, M. Nagl, and A. Zündorf, editors. Applications of Graph Transformations with Industrial Relevance AGTIVE'07, International Workshop Kassel, Lecture Notes in Computer Science 5088. Springer, Berlin