Modeling complex systems with Cellular Automata

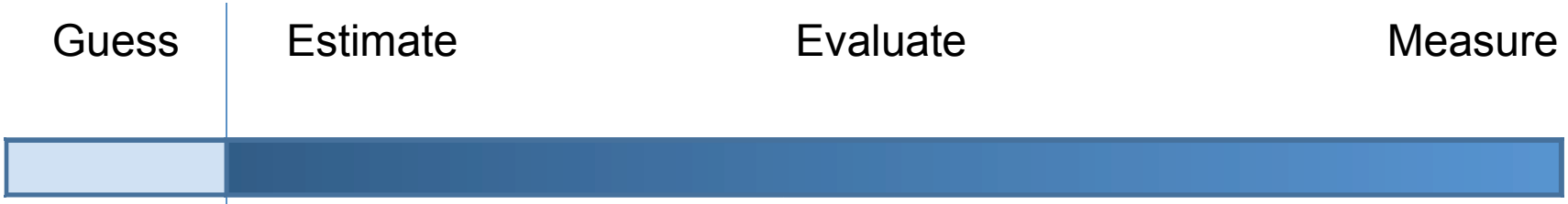
A.Makarovitsch – amakarovitsch@gmail.com
J-P. Foll – fojepi@gmail.com
P.Chauvet – pierre.chauvet@uco.fr
Institut de Mathématiques Appliquées
Université Catholique de l'Ouest
France

7th UES Congress – LISBON, December 2008

the origin/la source : http://www.afscet.asso.fr/resSystemica/Lisboa08/Makarovitsch3Lisboa08Modeling.pdf
the title/le titre : Modeling complex systems with Cellular Automata. (slides presentation)
the author/l'auteur : MAKAROVITSCH Alexandre, Jean-Pierre FOL & Pierre CHAUVET
the pages/la pagination : 8 p.
the year/l'année : 2008
& the book/la publication: 7th Systems Science European Union Congress Proceedings,
Lisboa, Portugal.

A step by step approach to model reality

From unstructured uncertainty to structured uncertainty and probability



Informal

Pure CA based Models

Models using MAS

Models with pseudo-agents
or « enhanced » CAs

CAs are:

- Simpler to develop and program
- Simpler to interpret and tune
- More flexible and controllable

CAs allow:

- To better follw-up the process
- To have a rule by rule control
- To analyze social phenomena

Modeling violence

Violence is a complex phenomenon due to:

- Individual characteristics of the involved persons
- Persons interactions (type and duration)
- Number of persons involved
- Situation and persons position in an environment
- Environment itself (which is generally complex)
- …

The ingredients

The environment (or world)

- A town with neighborhoods, access points, communications
- A square cells world with 8 neighbors for each cell

The actors we have chosen in a first step:

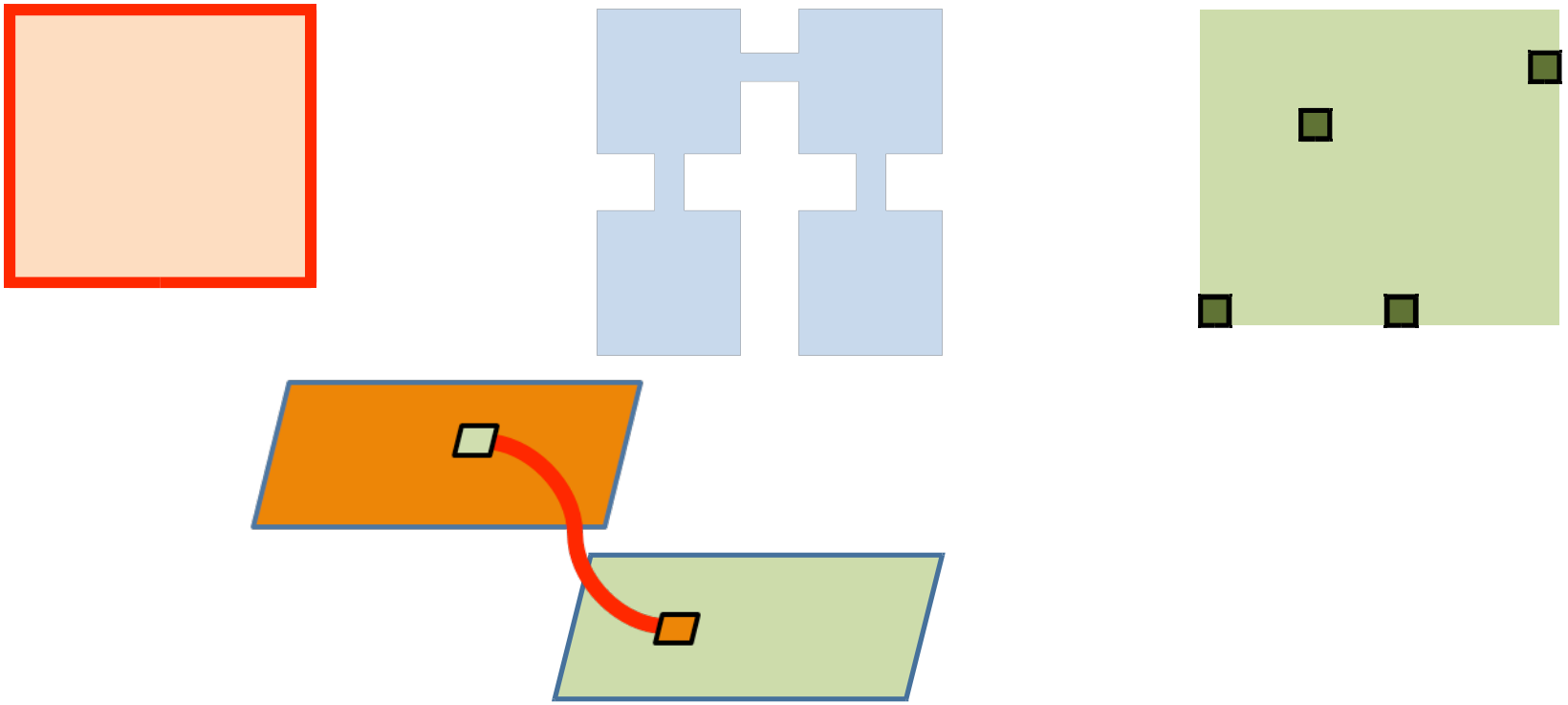
- Neutral citizen
- Violent citizen
- Police agent
- Educator
- Prisoner
- Informator
- Poor citizen

A set of rules to make actors interact

Specifics of the World

Possibility of having :

- ❖ Flat limited world
- ❖ Torus shaped world (no edges)
- ❖ Points of « emergence » of a state in the world (eg: airports, havens)
- ❖ Communication « roads » between otherwise unrelated parts
- ❖ Wormholes -borrowed from cosmology – to model underground comm.



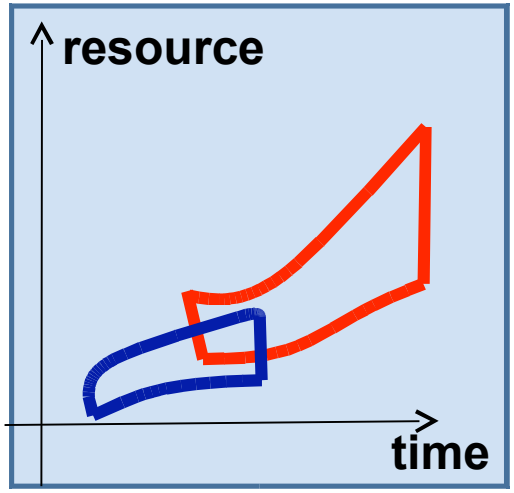
Main rules

- Rules are parametrable
- There are extensions, like the « vision »

Rule	Status at T	Nb	Type of surround	Status at T+1
1	Violent	2	Police	Prisoner
2	Neutral	2	Violent	Violent
3	Neutral	3	Police	Police
4	Neutral	3	Informers	Informer
5	Neutral	3	Poor	Poor
6	Poor	3	Violent	Violent
7	Informer	3	Violent	Neutral
8	Educator	2	Informer	Informer

Discussion and Comparison with MAS

❖ To be noted that the frontier between the two approaches is fuzzy
CAs could be extended and MAS could be restricted



❖ Full MAS need, for a successful implementation
highly qualified technical personnel
considerable financial resources (software, personnel, test fields long development and testing time

❖ Even full MAS do not provide guarantee on the result

❖ MAS could be developed by minimizing the financial resource only once aconvenient architecture is decided upon

❖ There are many cases where CA or enhanced CA is sufficient for getting the Necessary information to solve the problem at hand

To conclude

✓ **This research is on-going and we forsee to arrive at a more systematic build/change of the world, the rules and its extensions , the states.**

✓ **The wormhole concept (borrowed from physics) is a powerful amplifier of the model**

✓ **A tool box with an associated meta-language to enable a non-specialist person to build an automaton and put it at work is also foreseen.**

✓ **We affirm that the use of such a CA to better understand violence, ways to reduce it and help creating better living conditions in a town is a valid and affordable approach**

✓ **We are ready to share with other research teams to make the work progress faster and to enable the creation of an Internet dedicated site**