Multi-platform Training Sessions to Teach Agent-Based Simulation

MISS-ABMS 2-week Summer Schools organized every year since 2011 in Montpellier (France)

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Multi-platform International Summer School on Agent-Based Modelling & Simulation for Renewable Resources Management



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Principles, methods and technics of the various stages of ABMS (design, implementation and exploration)

- Focus on a participatory use of models and simulation (in relation to the **Companion Modelling** approach that was initiated in Montpellier in the 90's)
- Participants are requested to organize themselves into small groups of 2-4 to develop prototypes: the design stage can only be collaborative

Group work: setup during 1st week...

Day 1	Day 2	Day 3	Day 4	Day 5	
Welcome Session	Conceptual Modelling : theory,	Conceptual model Specifying the processes with UML	PPMs Groups		
Theory of modelling and simulation in the field of socio- ecosystems			Models calibration and analysis	dels calibration and analysis Coding Practice on 1 platform Benchmark Model Coding Practice on 1 platform For each platform Provisualisation For each platform For each platform of platform Specifities	
	Benchmark Model Conceptual Modelling	Benchmark Model			
ReHab Ice-breaking role-playing game		diagram	Benchmark Model For each platform Demo : monitoring and visualisation		
	Conceptual model Designing the structure with UML	Benchmark Model For each platform Metamodel of the scheduler Demo : implementation of dynamics			
			For each platform Demo of platform specifities		
Introduction to multi-agent systems and agent-based simulation	Benchmark Model UML Class diagram	Participants' Prototype Models (PPMs) Presentation and discussion	General discussion on platforms Choice of a platform	Participants' Prototype Models (PPMs)	
	Benchmark Model For each platform Metamodel of the platform Demo : implementation of structure and initialisation		Coding Practice on 1 platform	Story and conceptual model	
Uses of Agent-Based Models for socio-ecosystems : a panorama				Presentation of PPMs	
Plenary session Individual exercise					
Tools demo Plenary lecture (methodology) Group work					

MISS-ABMS Group work: main activity during 2nd week

Day 6	Day 7	Day 8	Day 9	Day 10
Case Study : a project with a conceptual model	Case Study : a project with CORMAS platform	Case Study : a project with GAMA platform	Case Study : Wat-A-Game + a project with Netlogo platform	Preparation of PPMs presentation & demo
Participants' Prototype Models (PPMs) Class diagram, structure and intialisation	Participants' Prototype Models (PPMs) Sequence diagram and global dynamics	Participants' Prototype Models (PPMs) Activity diagrams and agents behaviours	Participants' Prototype Models (PPMs) Indicators, visualisation and analysis	Presentation and demo of PPMs
				Final debriefing
Documentation of ABMs		Validation of models		
	Participants' Prototype Models	General discussion on validation	Participants' Prototype Models	
Participants' Prototype Models (PPMs)(PPMs)Class diagram, structure and intialisationdynamics	Participants' Prototype Models (PPMs) Activity diagrams and agents behaviours	<i>(PPMs)</i> Indicators, visualisation and analysis		
PPMs - static Presentation to another group	PPMs - global dynamics Presentation to another group	PPMs - agents behaviours Presentation to another group	PPMs - visualisation Presentation to another group	

Summer School Diner



MISS-ABMS Setting-up a worldwide network



MISS-ABMS Diversity of participants



Triplication of a benchmark model

Day 1	Day 2	Day 3	Day 4	Day 5			
Welcome Session	Conceptual Modelling : theory,	Conceptual model Specifying the processes with UML	PPMs Groups				
Theory of modelling and simulation in the field of socio-ecosystems	concepts and practice		Models calibration and analysis Coding Practice of Benchmark Model For each platform Demo : monitoring and visualisation				
	Benchmark Model Conceptual Modelling	Benchmark Model		Coding Practice on 1 platform			
ReHab Ice-breaking role-playing game	Conceptual model Designing the structure with UML	diagram					
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Introduction to multi-agent systems and agent-based simulation	Benchmark Model UML Class diagram	Participants' Prototype Models (PPMs) Presentation and discussion	General discussion on platforms Choice of a platform	Participants' Prototype Models (PPMs)			
	Benchmark Model For each platform Metamodel of the platform Demo : implementation of structure and initialisation		Coding Practice on 1 platform	Story and conceptual model			
Uses of Agent-Based Models for socio-ecosystems : a panorama				Presentation of PPMs			
Plenary session Individual exercise Tools demo Group work							

Implementing the same benchmark model with various ABM platforms



When the implementations are performed by the same computer scientists, there is a bias due to the unequal command of the different platforms

MISS-ABMS Triplication of a benchmark model by experts of the 3 platforms



MISS-ABMS Benchmark model: verbal description

- A landscape displays a random pattern with half forested plots and half cleared plots. The area represents 900 Ha of a fire-prone monospecific open forest that is divided in plots of 1 Ha. When a fire breaks out, it spreads swiftly around the landscape by setting ablaze all neighboring forested plots.
- A voluntary forest fire-fighting brigade made of 10 firefighters is monitoring the forest. Each firefighter patrols the forest by moving randomly from one plot to a surrounding plot. When detecting a burning plot around its location, a firefighter goes to the fire site to extinguish it.
- In a first scenario, firefighters act independently: they have no mean to know where the other fighters are located and what they are currently doing.
- In a second scenario, the location and the status (fighting a fire or patrolling) of each firefighter are known to all. When a firefighter does not detect any fire around his/her own location, he/she moves towards the closest fire fought by one the other firefighters if any, else he/she continues patrolling
- Compare the two scenarios when initially a fire breaks out in a forested plot randomly picked.

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elements attributes data <u>processes</u> <u>relationships</u>

MISS-ABMS Benchmark model: differences in design

 Implicit assumptions about time
 ✓ Speed of fire spreading relative to duration of firefighters' activities

□Implicit assumptions about space
✓ Neighborhood: 4-6-8 ???

MISS-ABMS Benchmark model: a unified design (UML)



Benchmark model: simulation outputs

- □ The importance of observation
 - Running simulations to figure out if the model is right (verifying that what is exhibited corresponds to what was supposed to be coded)
 - ✓ Running simulations to identify meaningful indicators
 - o Time to extinguish the fire
 - $\circ~$ Size of the remaining forest
- Mastering the dimensions of stochasticity
 - ✓ Specifying an initial landscape ?

Comparison of the 3 implementations still to be carefully conducted

MISS-ABMS Take-home messages

With their unexpected behavior, trainees are gifted for tracking down highly unlikely bugs... Training sessions help enhancing the robustness of platforms!

Trainers are also learning!

- ✓ new ideas for improving the platforms from deeper look into other platforms,
- ✓ detection and specification of agent-based modeling primitives (AMPs)* usable in the various platforms

□ 2016 edition: http://www.agropolis.org/miss-abms/