VLE-Surveillance package

A modular simulation tool

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What do we expect from this tool?

Material & methods: Modelling formalism & software systems

Presentation of the simulation tool

Prototype demonstration

Case study: test CR methods for HPAI in Thailand
What we expect from this tool?

Simulate:
- The disease spread
- The data collection performed by the surveillance system
- The disease control (TO DO)

In order to:
- Quantitatively evaluate adequacy between surveillance system estimation and epidemic
- Optimize the sampling process parameterization
- Present the surveillance system sampling strategy in a didactic and/or contextualized way
Presentation guideline

1. What do we expect from this tool?

2. Material & methods: Modelling formalism & software systems
   - Dynamical systems modelling with DEVS
   - Simulators development environment: VLE software

3. Presentation of the simulation tool

4. Prototype demonstration

5. Case study: test CR methods for HPAI in Thailand
Discrete Event System Specification (DEVS)

Dynamic system specification (Zeigler 2000)

A mathematical structure to represent dynamical systems:
\[ \langle X, Y, S, \delta_{ext}, \delta_{int}, \delta_{con}, \lambda, ta \rangle \]

([Zeigler et al. (2000) Zeigler, Kim, and Praehofer])
Discrete Event System Specification (DEVS)

- Rigorous and complete specification
- Modularity and hierarchical decomposition

- Multi-formalism
  - Discrete time systems
  - Differential equations
  - Discretized systems
  - Quantized systems
Discrete Event System Specification (DEVS)

Experimental frame specification

![Diagram of Experimental Frame and Model]

- Inputs
- Model: Initial state, Parameters, Dynamics
- Observations
Virtual Laboratory Environment (VLE) software

Model structure specification
Virtual Laboratory Environment (VLE) software

Model structure specification
Virtual Laboratory Environment (VLE) software

Model Dynamic specification
Virtual Laboratory Environment (VLE) software

Experiment specification
Presentation guideline

1. What do we expect from this tool?

2. Material & methods: Modelling formalism & software systems

3. Presentation of the simulation tool
   - Disease spread modular model
   - Surveillance modular model
   - Simulation tools outputs

4. Prototype demonstration

5. Case study: test CR methods for HPAI in Thailand
Disease spread model

- Epidemiological units: Building model library
  - Automaton models SIR, SEIR, SIRS, ...
  - Differential equation models SIR, SEIR, SIRS, ...
- In an infectious contact network
Surveillance model

Set of surveillance components

Two kinds of components:
- Pro-active
- Event-based

Main features:
- Observation policy
- Perception error
- Analyse features
Simulation tools outputs

- Visualize results of a single experiment
- Test surveillance protocols with experimental plans

Summary charts
Presentation guideline

1. What do we expect from this tool?
2. Material & methods: Modelling formalism & software systems
3. Presentation of the simulation tool

4. Prototype demonstration
   - Single experiment
   - Experiment plans using R software

5. Case study: test CR methods for HPAI in Thailand
1 What do we expect from this tool?

2 Material & methods: Modelling formalism & software systems

3 Presentation of the simulation tool

4 Prototype demonstration

5 Case study: test CR methods for HPAI in Thailand
Test CR methods in the context of 2004 HPAI epidemics in Thailand
Starting collaboration CIRAD/INRA/KU/DLD

- Disease spread model:
  Reconstitute the context of the first wave epidemics of HPAI in Thailand in 4 provinces of Thailand

- Surveillance model:
  - Reconstitute the Thai surveillance systems data collection
  - Use Capture-Recapture method to analyse data

- Disease control model:
  Thailand legislation during this period (evolution)
Conclusion: A simulation tool to help surveillance system design

- To evaluate quantitatively new sampling strategies
- Present and discuss these new strategies using didactic visualization features
- A tool at prototype stage but modular and scalable
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Recursive simulation and experimental frame for multiscale simulation.


B. P. Zeigler, T. G. Kim, and H. Praehofer.
*Theory of modeling and simulation: Integrating Discrete Event and Continuous Complex Dynamic Systems.*