Instructions to run the Agent-Based Model:

"Imperfect knowledge and stable governance in democracies"

Carlos M. Fernández-Márquez (carlosm.fernandez@uam.es)
Francisco J. Vázquez and Luis Fernando Medina

The model is coded in Java using an extension of Repast v3.1.

The only requisite is to have installed Java Runtime Environment (JRE). The model and all dependences are included in the .jar binary file.

The program can be executed in both a graphical and batch mode:

- Graphical mode:
  - Advantages:
    - We can see the evolution of the system: how opinions evolve and their distribution in the ideological space, how the relationships between voters take place, the relative importance between parties, etc.
    - We can set the parameters of the system in a graphical way.
  - Disadvantages:
    - No output is recorded.
    - Only one realization is taken into account.
    - Suitable only for an informal or preliminary study of the model.

- Batch mode:
  - Advantages:
    - All data of interest in the evolution of the system is recorded in output files.
    - An arbitrary set of simulations can be carried out in a massive parallel way. One core one parametric scenario with the desired number of random realizations to carry out (read below to see how).
    - Suitable for sophisticated statistical analysis.
  - Disadvantages:
    - Blind evolution of the system.

To run the model for a certain parametric scenario, we need a command line console and use the next syntax:

java -server -XX:ParallelGCThreads=2 -Xms1000m -Xmx1500m -jar NOSv82SpatialModel.jar realizacionIni=StartingRealization realizacionFin=EndingRealization N=PopulationSize alfa=ParameterAlpha beta=ParameterBeta p=parameterP k=ParameterU ra=ParameterR rr=ParameterR M=ParameterM periodosTotales=TotalTime

periodosConsiderados=PeriodsToRecord paso=StepToRecord d=Dimension modo=Mode simulacionID=ID

If you need to execute the model for different scenarios, you will have to code a command line script that calls the above mentioned line changing the argument setting according to your needs. A good practice to carry out a massive parallel simulation is to simulate each scenario in a different core of a clustering computer. If a realization is too light to be executed in an independent core, you can group by scenarios. Below, we comment all part of the syntax (not always by calling order):

- **"java":** It is for calling to Java interpreter (Java Virtual Machine or just JVM). Optional parameters of JVM:
    - **"-server":** It is an optimized mode for batch execution.
    - **"-XX:ParallelGCThreads=2":** It is to order two threads for liberating unused object from memory as fast as possible. The model creates and destroys objects frequently, so if they are not deleted quickly the lack of memory can act as a bottleneck in the time execution of the program.
    - "**-Xms1000m":** It is to reserve at least 1000Mb of memory for the execution of the program.
    - **"-Xmx1500m":** It is to reserve at most 1500Mb of memory.
    - **"-jar":** It tells JVM the executable is a .jar file.
    - **"NOSv82SpatialModel.jar":** It is the name of the model's executable file.

- **"modo=Mode":** "g" for a graphical execution (all arguments will be ignored) and "b" for batch one.

- **"realizacionIni=StartingRealization" "realizacionFin=EndingRealization":** It is for grouping (for serial execution) the realizations between StartingRealization and EndingRealization of a parametric scenario into the same core. So, you can split one scenario into several cores.

- **"periodosTotales=TotalTime":** Number of periods (elections) to be simulated.

- **"periodosConsiderados=PeriodsToRecord":** Periods to record in output files (counting from the last simulated period).

- **"paso=StepToRecord":** Frequency of recording in output files.

- Parameters of the model:
    - **"N=PopulationSize":** Number of individuals (voters).
    - **"M=ParameterM":** Number of parties (a grid of MxM).
    - **"alfa=ParameterAlpha":** Ideological fragmentation.
    - **"beta=ParameterBeta":** Velocity of the local convergence.
    - **"p=parameterP":** Probability for random ideology updating
    - **"ra=ParameterR" "rr=ParameterR":** Ideological uncertainty (in this version of the model ra=rr)
    - **"k=ParameterU":** Weight of strategic effect of voting
    - **"d=Dimension":** Number of dimensions of the ideological space.

- **“simulacionID=ID”:** ID of the parametric scenario (the same for all realizations of a certain scenario).

Examples:

- java -server -XX:ParallelGCThreads=2 -Xms1000m -Xmx1500m -jar NOSv82SpatialModel.jar realizacionIni=1 realizacionFin=50 N=250 alfa=30 beta=5 p=0.005 k=0.7 ra=0.2 rr=0.2 M=4 periodosTotales=6000 periodosConsiderados=6000 paso=1 d=2 modo=b simulacionID=5300

  java -server -XX:ParallelGCThreads=2 -Xms1000m -Xmx1500m -jar NOSv82SpatialModel.jar realizacionIni=51 realizacionFin=100 N=250 alfa=30 beta=5 p=0.005 k=0.7 ra=0.2 rr=0.2 M=4 periodosTotales=6000 periodosConsiderados=6000 paso=1 d=2 modo=b simulacionID=5300

  The parametric scenario (N=250 alfa=30 beta=5 p=0.005 k=0.7 ra=0.2 rr=0.2 M=4 and identify by the number 5300) is executed 100 times (50 in a core and 50 in other).

Output files

The model generates relational tables in text format that can be loaded and analyze whatever statistical program (such as, for example, R-Project).

- **s[SimulationID]PARAMETROS.txt:** It is generated by each parametrical scenario to link each SimulationID with each parametrical setting.

- **s[SimulationID]AGREGADOS.txt:** It is generated by each group of parametric scenario. Variables:
  - **t:** Time (repeated for all parties’ entries).
  - **e:** Realization (repeated for all periods).
  - **sim:** SimulationID (repeated for all realizations).
  - **fila:** Row that is occupied by the party in the grid.
  - **columna:** Column that is occupied by the party in the grid.
  - **votos:** Number of votes of the party.
  - **esGobernante:** if this party take part in the government (binary variable).
  - **cambioGobierno:** an aggregate binary variable that indicate if the government has or not change from last period (election). Repeated for all parties.