Developing Spatiotemporal Features of DISPAS 2.0 Simulator

Nieto Coria C. A.[a], Scarcella G.[b], Tesei L.[a], Merelli E.[a]

[a]*School of Science and Technology, Computer Science Division, University of Camerino, Via Del Bastione 1, 62032 Camerino; e-mail:* {cesar.nietocoria,luca.tesei, emanuela.merelli}@unicam.it
[b]*National Research Council - Institute of Marine Sciences Ancona, L.go fiera della pesca SNC - 60125 Ancona; e-mail*: giuseppe.scarcella@an.ismar.cnr.it

DISPAS 1.0 [1] is an agent-based simulator that performs the stock assessment of the common sole *(Solea solea L.)* in the Northern and Central Adriatic Sea. It implements probabilistic monthly-based simulations over time considering an average square kilometer of sea.

In [2] the first ideas on expanding DISPAS 1.0 on the spatial scale were put in place by introducing the notion of macro-agents representing the fish population of a certain hexagonal area of the sea located in specific coordinates. Then, the ideas were further developed in [3] by defining a multi-scale simulation model based on the computational model of Complex Automata. This model has been implemented in DISPAS 2.0, the new spatiotemporal version of the simulator, which includes the following features.

First, an integration with a Geographical Information System (GIS) was added in order to place each hexagonal agent in its exact coordinates in the Adriatic Sea. The GIS tool permits to perform spatial queries that are used, for example, to define the neighborhood of each agent or to select only the hexagons in which the common sole is present. Second, each agent has been equipped with its own parameters for natural/fishing mortality probability and growth factor. The population of each hexagon is represented as a number of individuals, normally distributed on age, divided by annual cohorts. The population stochastically evolves over time considering the mortality, the introduction of newborns and the input/output due to migration. Finally, a mechanism of communication of agents with their neighbors was developed, which is used, for instance, to correctly implement the migratory flux.

References:

1) Penna, P., Paoletti, N., Scarcella, G., and Tesei, L., Marini, M., Merelli, E. “DISPAS: An Agent-Based Tool for the Management of Fishing Effort.” In: Software Engineering and Formal Methods. SEFM 2013 Collocated Workshops. Vol. 8368 of Lecture Notes in Computer Science, Springer International Publishing, **2014**, pp. 362-367.

2) Nieto Coria, C. A., Scarcella, G and Tesei, L. “Introducing Space and Spatial Interactions in DISPAS: Demersal Fish Probabilistic Agent-based Simulator”. In: Book of Abstracts of the 4th Scientific Day of School of Science and Technology, **2014**, pages 33–33.

3) Nieto Coria, C. A., Tesei, L., Scarcella, G., Russo, T., and Merelli, E. “Sea-Scale Agent-Based Simulator of Solea solea in the Adriatic Sea”. In: Software Engineering and Formal Methods. SEFM 2014 Collocated Workshops. Vol. 8938 of Lecture Notes in Computer Science, Springer International Publishing, **2015**, pp. 259-275.