ETHlogo

**Lecture with Computer Exercises:**

**Modelling and Simulating Social Systems with MATLAB**

Project Report

|  |
| --- |
| Insert Title Here  … |

Jonas Purtschert & Luca Tondelli

Zürich

Date 05.05.2014

**IMPORTANT**

**You MUST include the ETH declaration of originality here; it is available for download on the course website or at**

**http://www.ethz.ch/faculty/exams/plagiarism/index\_EN;**

**It can be printed as pdf and should be filled out in handwriting.**

**Agreement for free-download**

We hereby agree to make our source code of this project freely available for download from the web pages of the SOMS chair. Furthermore, we assure that all source code is written by ourselves and is not violating any copyright restrictions.

|  |  |
| --- | --- |
| Name 1 | Name 2 |

# Table of content

# Abstract

This paper examines the predator-prey swarming model published by Vladimir Zhdakin and J. C. Sprott in 2010. Firstly the model is explained and all of its variations are mentioned. Then the results that got published in the paper mentioned above are compared to the new created results to check if the new implementation fits the one made by V. Zhdakin and J. C. Sprott.

Next it discusses how each parameter of the model influences the results, how they should be interpreted and there is an explanation of how they are connected.

Another important point is the question which parameters deliver the most realistic results. It is determined what range the parameters should be chosen to create a simulation as close to the real world as the model allows.

At last there is discussed which aspects of swarming and hunting behaviours of fishes are fulfilled and which are not.

# Individual contributions

Vladimir Zhdakin

J. C. Sprott

# Introduction and Motivations

A fish swarm that is under attack by sharks are spectacular to watch. It moves as a unit to minimize every fish’s risk of getting killed. There are many models that try to describe and examine the movement of the swarm and the predators. One of it is an agent-based model by Vladimir Zhdakin and J. C. Sprott that tries to reproduce the movement by only using forces between the agents.

# Description of the Model

The model consists of two agents, predators and preys. They are both simulated on a two and three dimensional Cartesian plane. With the three dimensional plane we want to get a more realistic simulation of a swarm and predators.

Because the model will be kept as simple as possible the agents do only interact with the environment via a friction.

All forces between the agents are directed radially from the agents. Prey pairs interact with long range attractive and short range repulsive forces with each other to model the behaviour in a swarm as the single members try to stay at a certain distance from each other. Predator – prey pairs both interact with an anti Newtonian force.

This model will use three different forces between predator pairs which all occur in nature. First there is no interaction between predators what will simulate attackers which do not hunt or interact with each other. Second is an attractive force between the predators so they can form a group of predators to chase the swarm. Thirdly this paper will explore a repulsive force between the predators. This could be a model of predators trying to attack a swarm from different sides to confuse them. Because the anti-Newtonian force is non conservative the system is able to stay indefinitely in motion.

The long range and short range force fij, gij between agent i due to agent j are given by:

Where is the distance between agent i and j, and are the force parameters for long range attractive and short range repulsive force respectively. The model will use since this will result in the most realistic swarming behaviour. Long range force will only be used for attraction and short range for repulsion.

The resulting force for the motion of a prey is:

Where m is the mass of a prey, b0 the coefficient of friction. The subscript 0 denotes parameters of prey agents whereas x denotes parameters of predators.

An additional restriction to the above formula is . The first sum adds all forces acting on prey i due to all other preys (except i). The second adds all forces acting on prey i due to all predators minus the friction of the prey.

# Implementation

# Simulation Results and Discussion

# Summary and Outlook

# References