“Stressed-out” agents

Workshop – 14-16/02/2017

Basic principle: agent-based model

Agent-Based Modeling is a computational model for simulating the actions and interactions of autonomous agents.

The basic idea is to use the ABM into a **physical system**, where the agents are objects created by **sources** that follows laws in terms of **interaction, attraction and repulsion**.

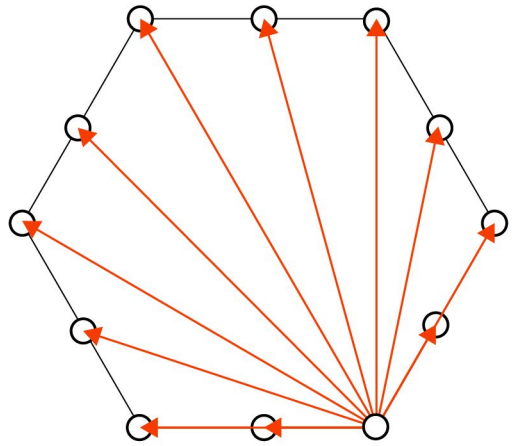
Approach 1

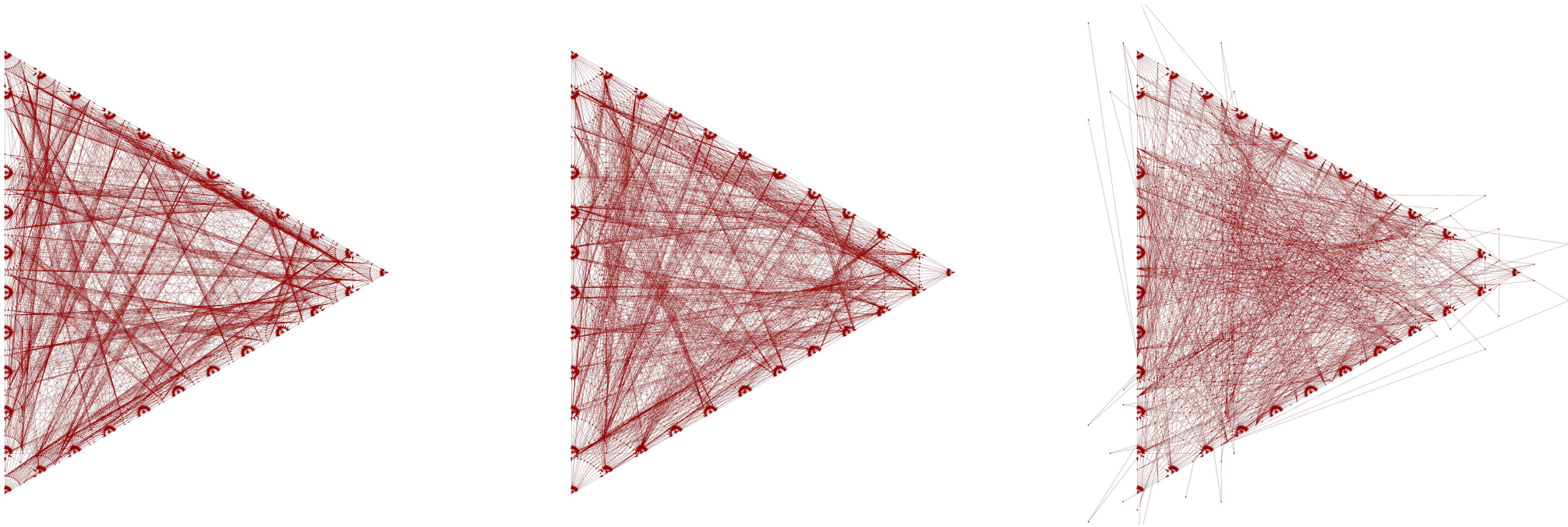
Phase 0

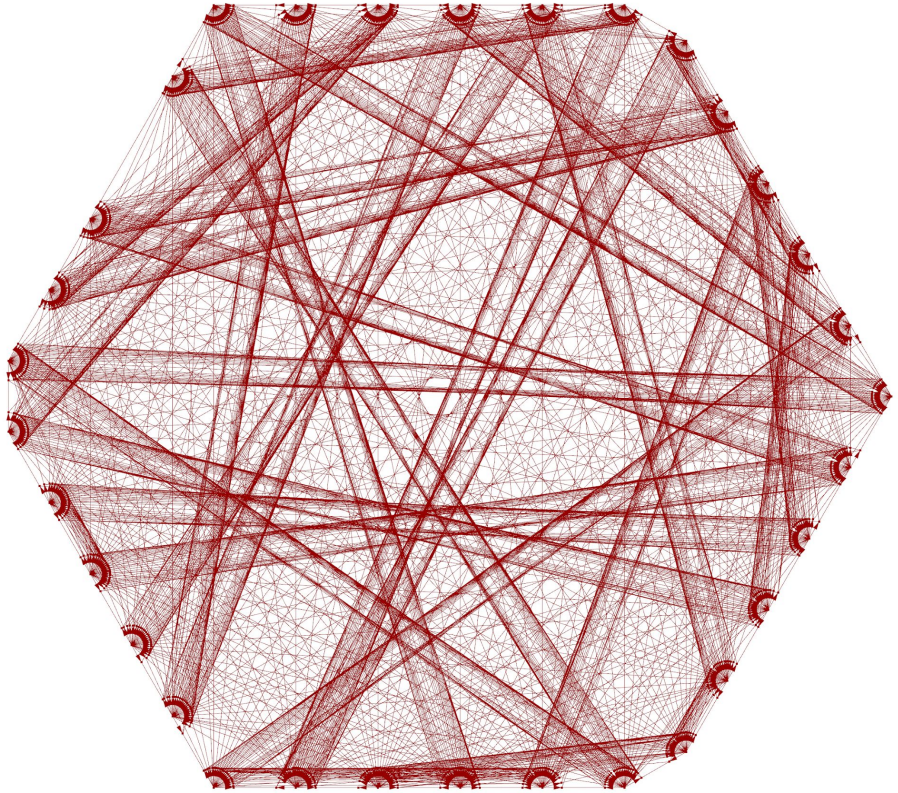
Sources along a **fixed boundary**

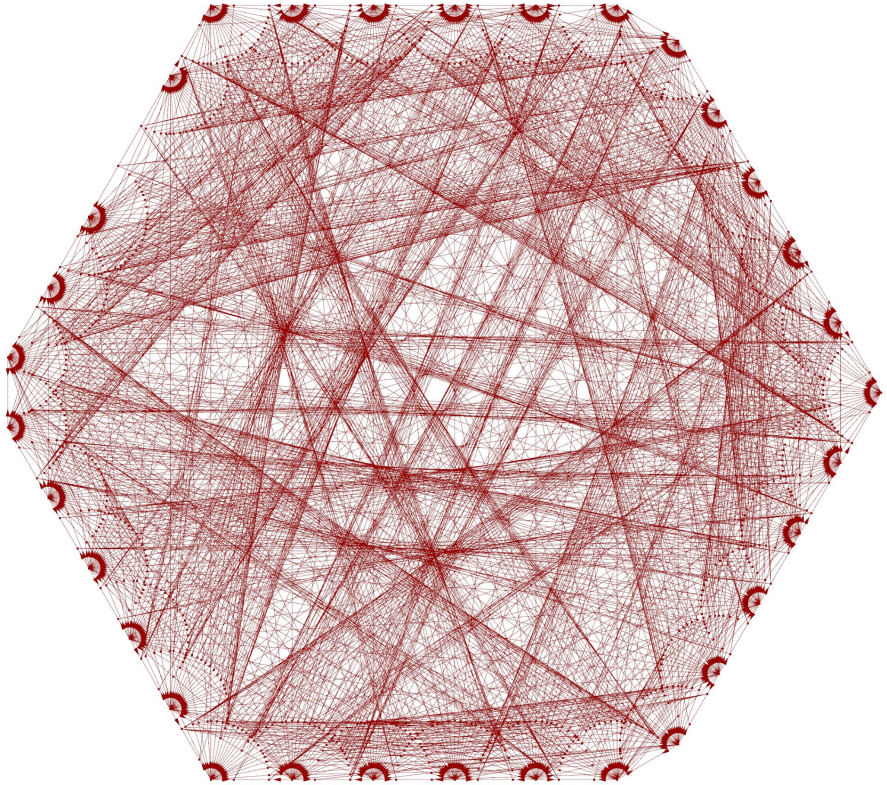
Each source generates a fixed number of **agents**, that corresponds to the same as the number of other sources

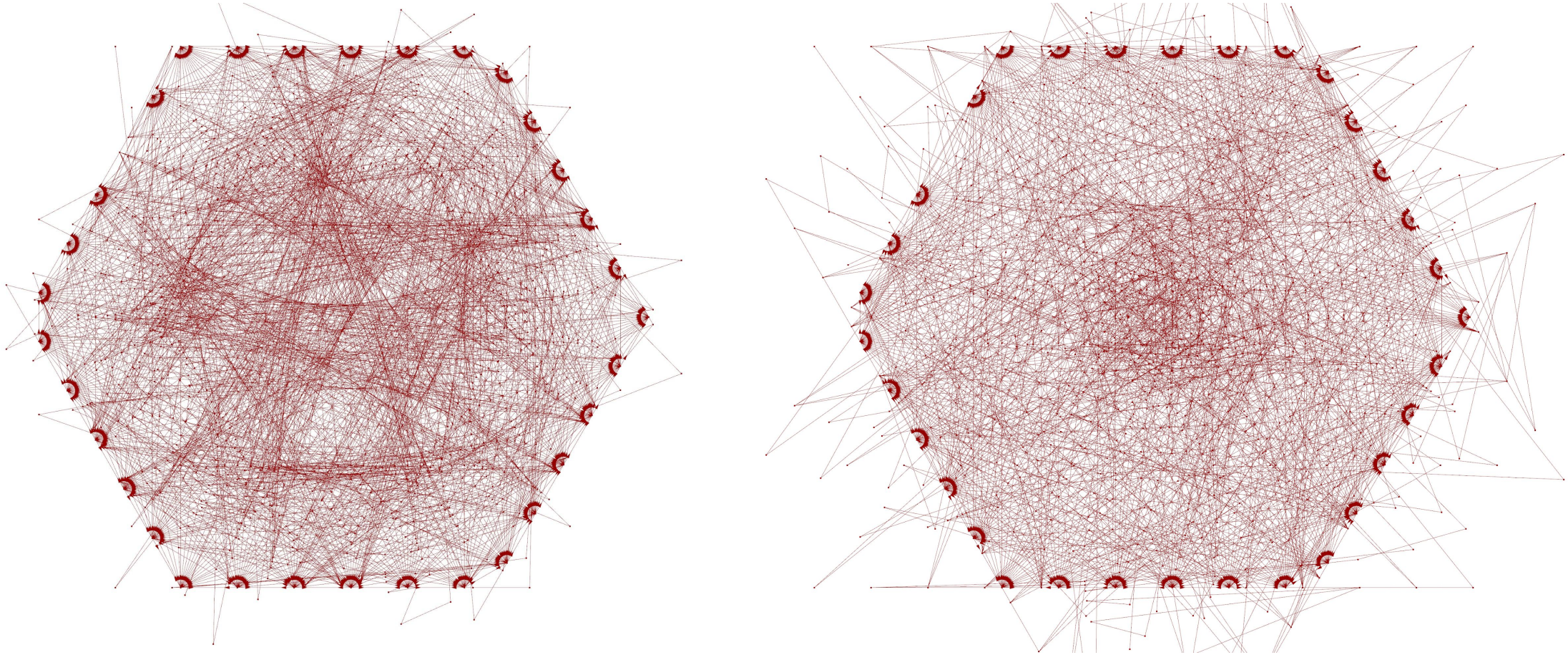
Each other source is an **attraction** for the agents









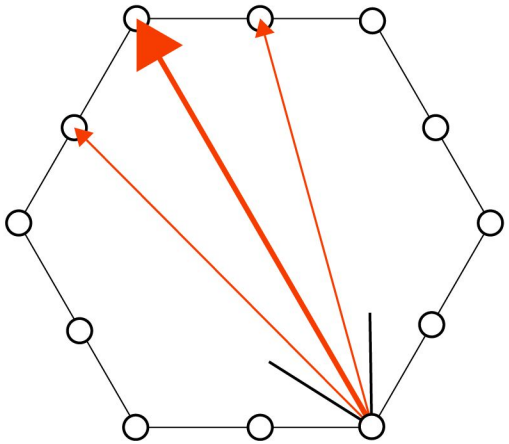


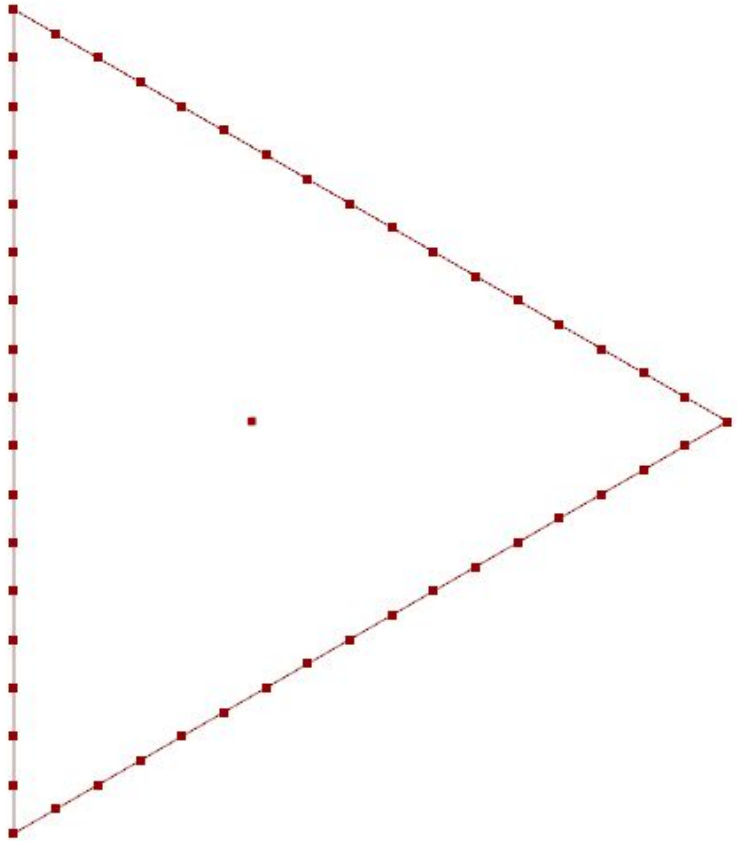
Phase 1

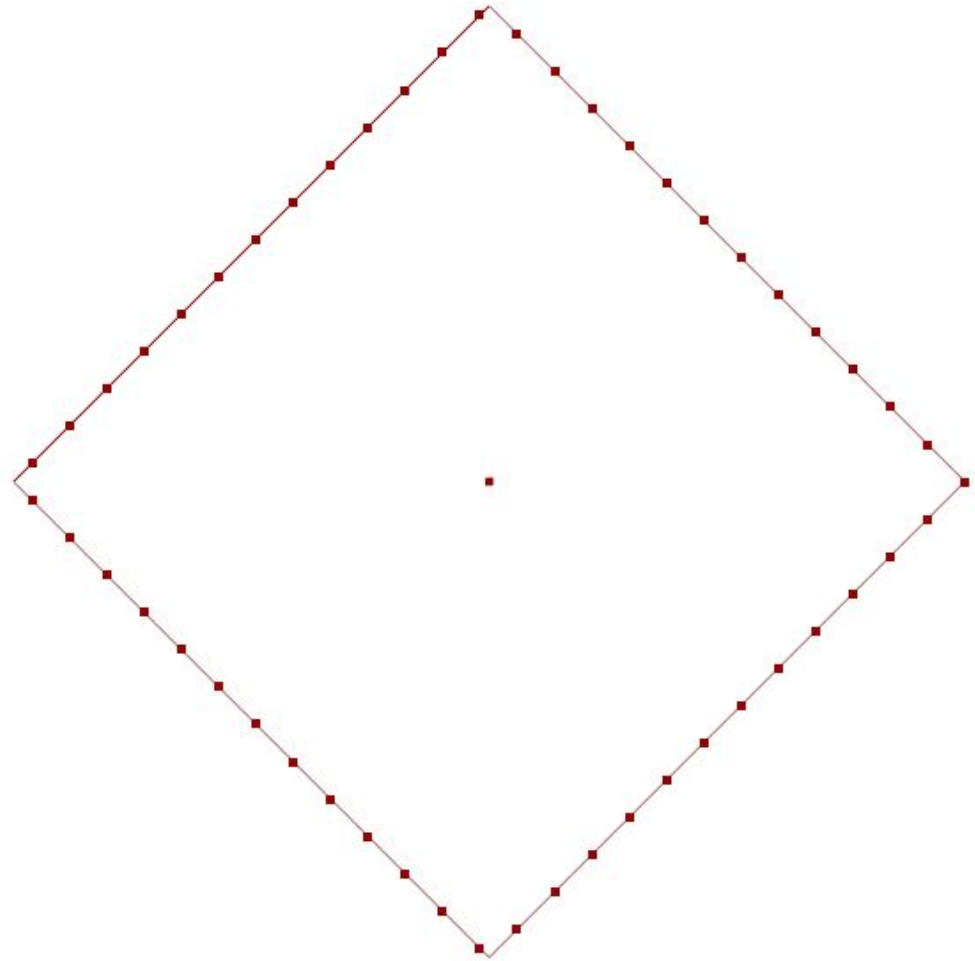
Sources along a **fixed boundary** (both in 2D and 3D)

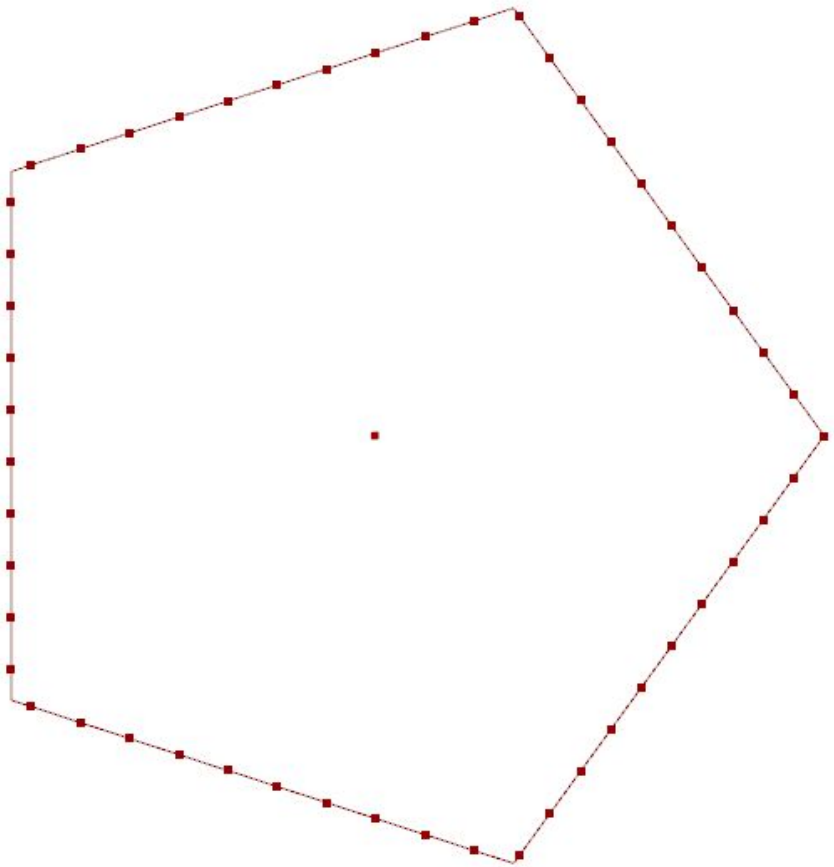
Each source generates **only one agent**

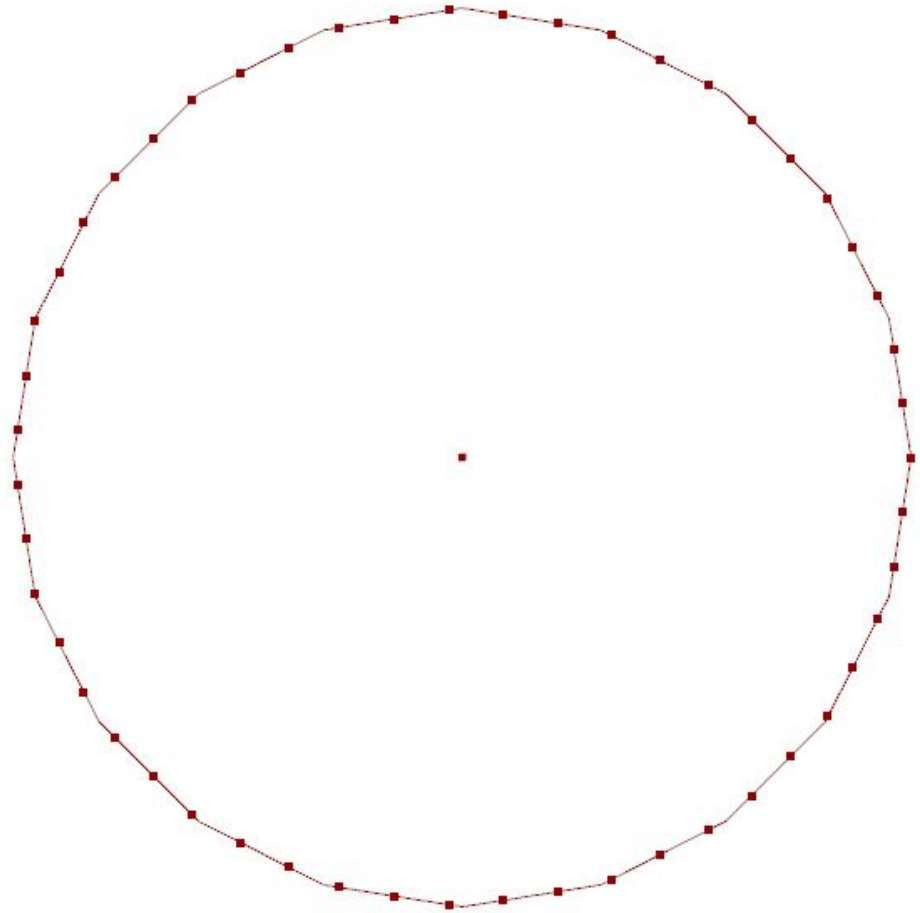
The agent has **one specific target**, that is the furthest agents' source with respect to its origin and is inside its **visual cone**

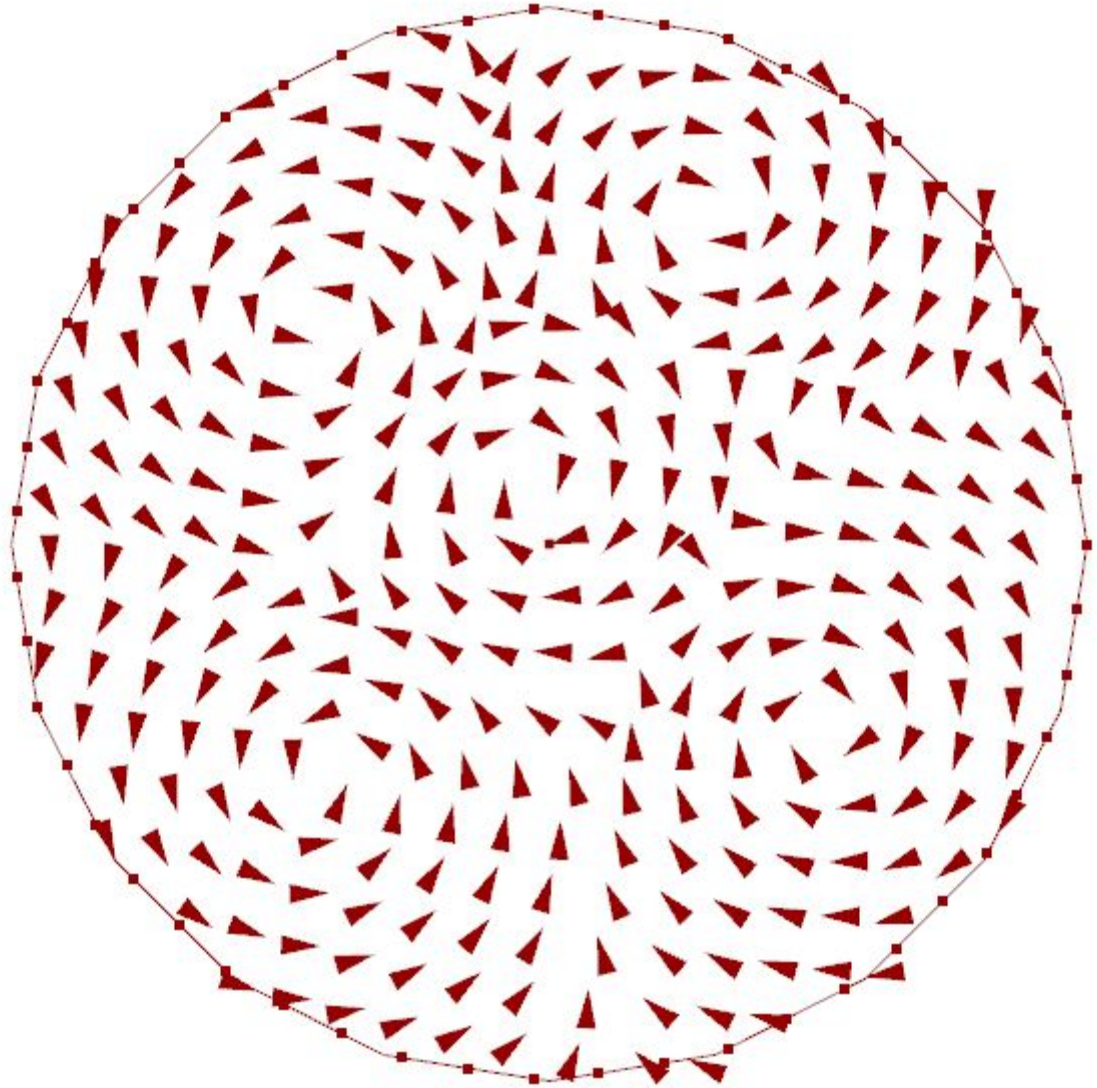


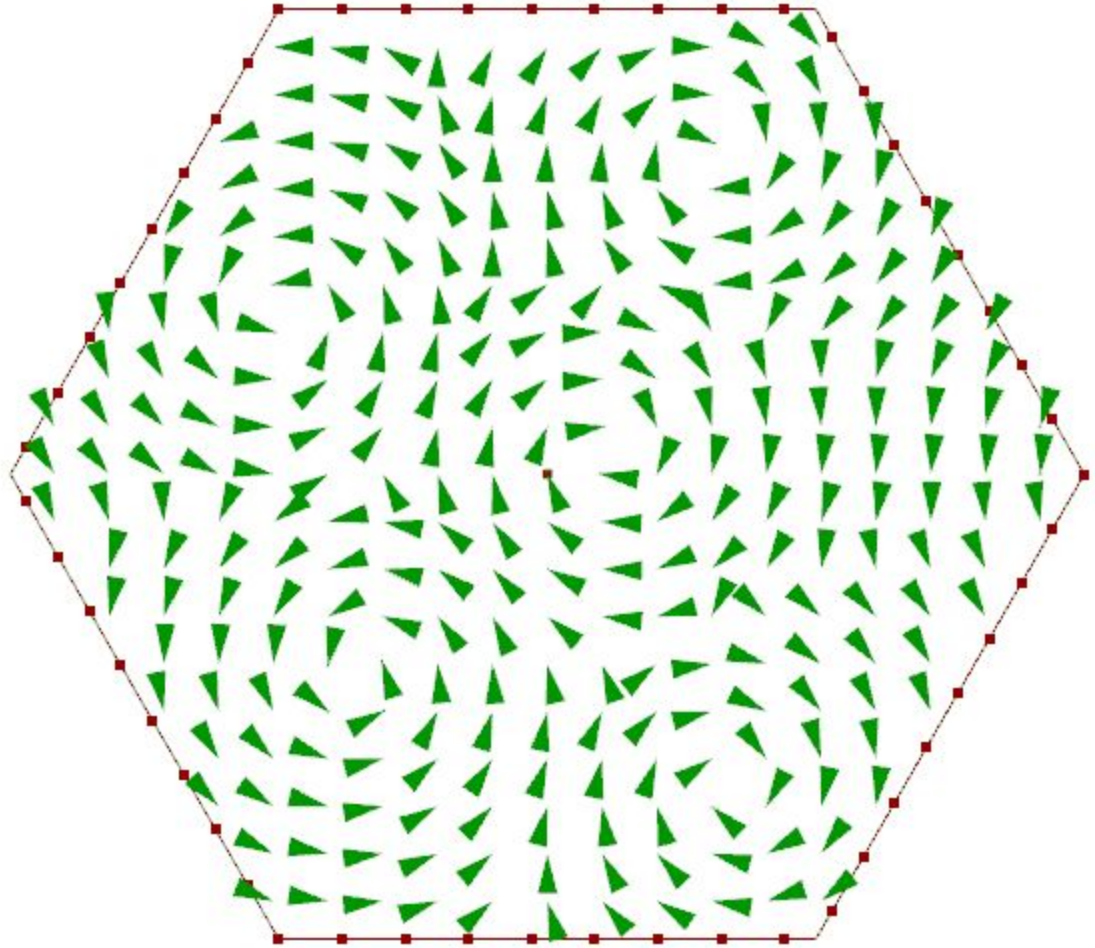


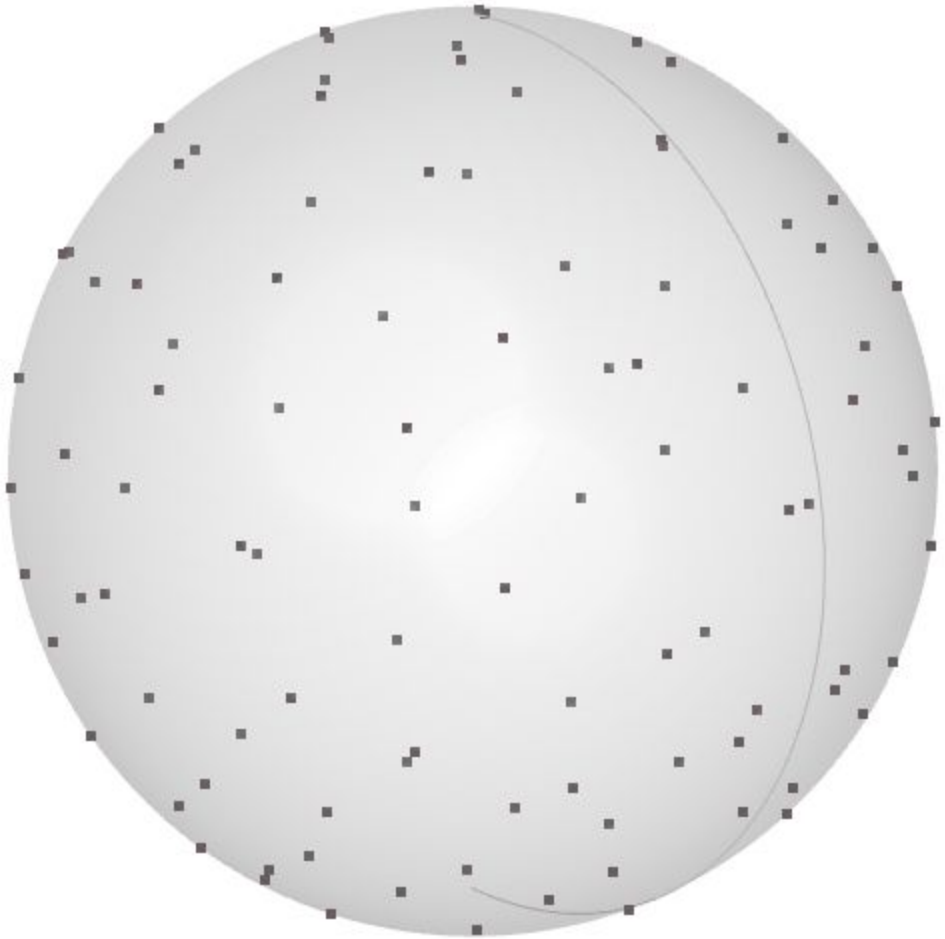


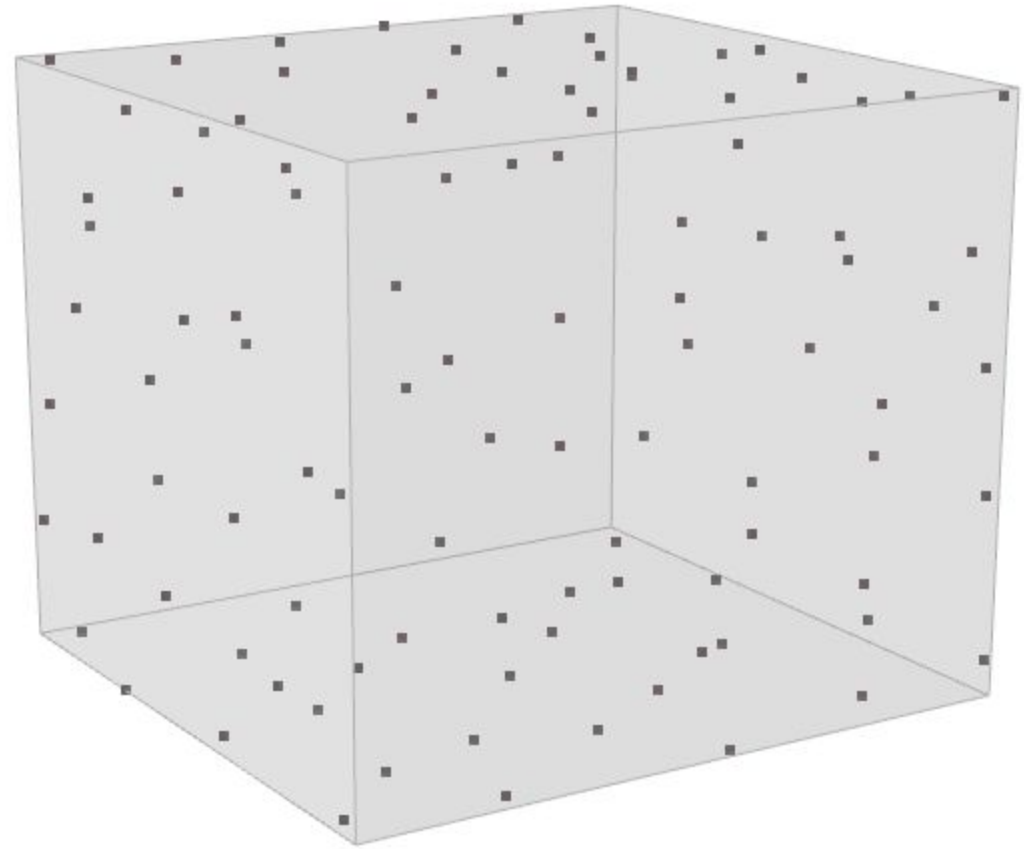










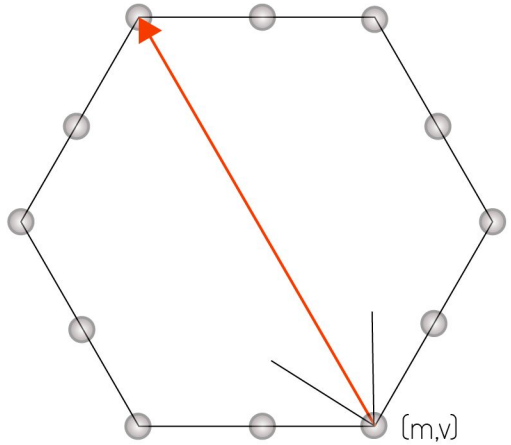


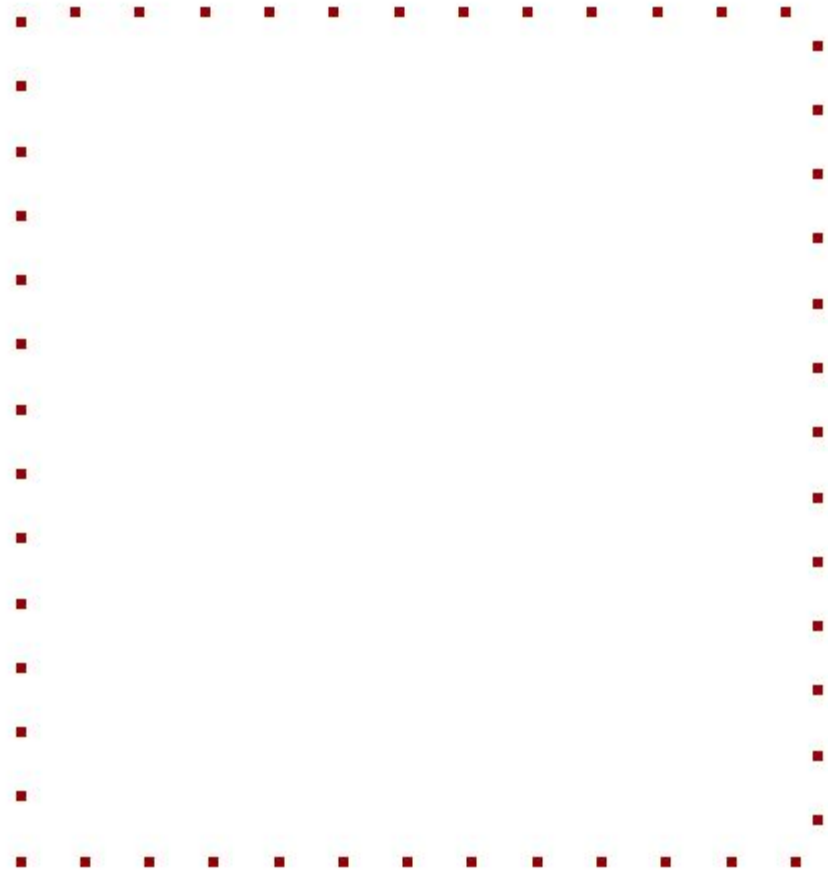
Phase 2

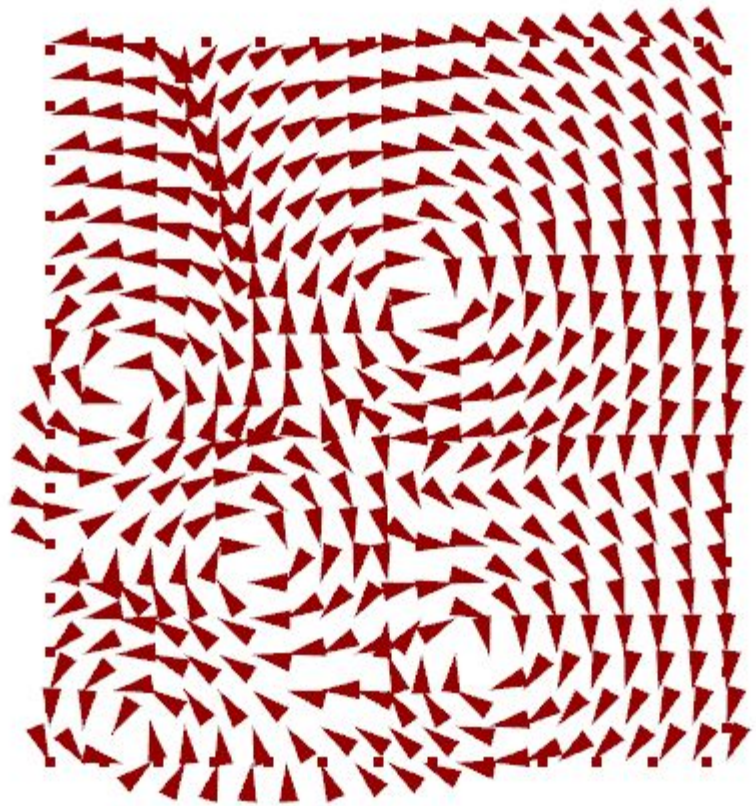
Each agent has an assigned random value of **mass**, that is used in the acceleration evaluation process ($a=F/m$) and in the gravitational force evaluation process, between two agents ($F_G=Gm_1m_2/r_{12}^2$)

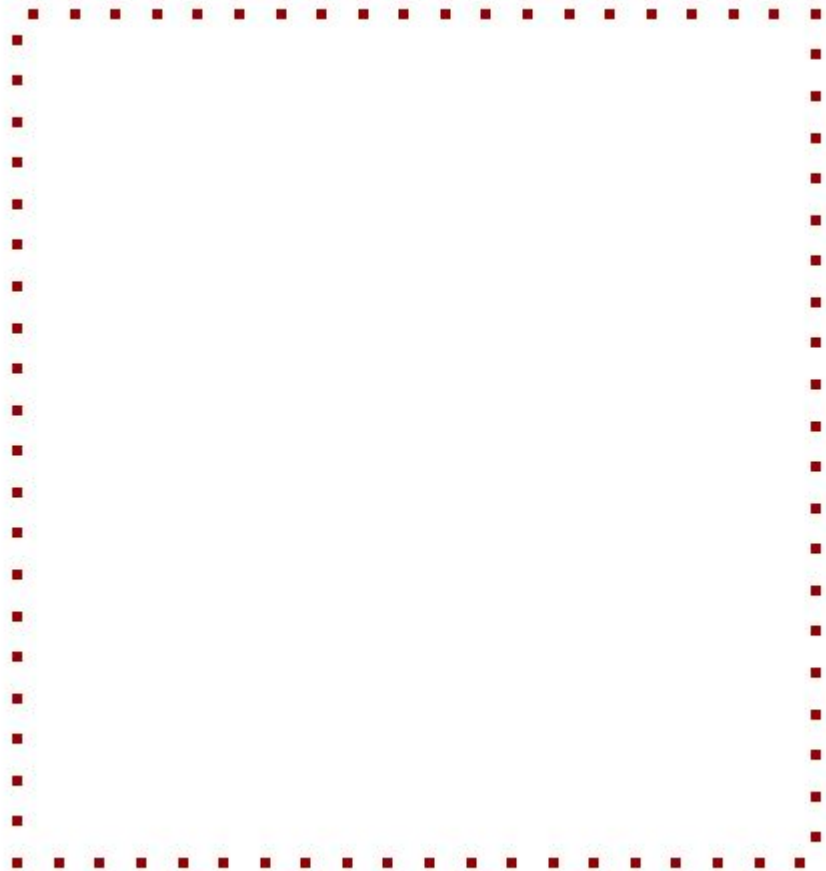
The agents are visualized as **spheres** (instead of points), with the center in the agent's position and the radius corresponding to their mass

For each time step, along with the location update also a **velocity check** is running: if it is higher than a user input value (M_v), the velocity is automatically scaled to the maximum value







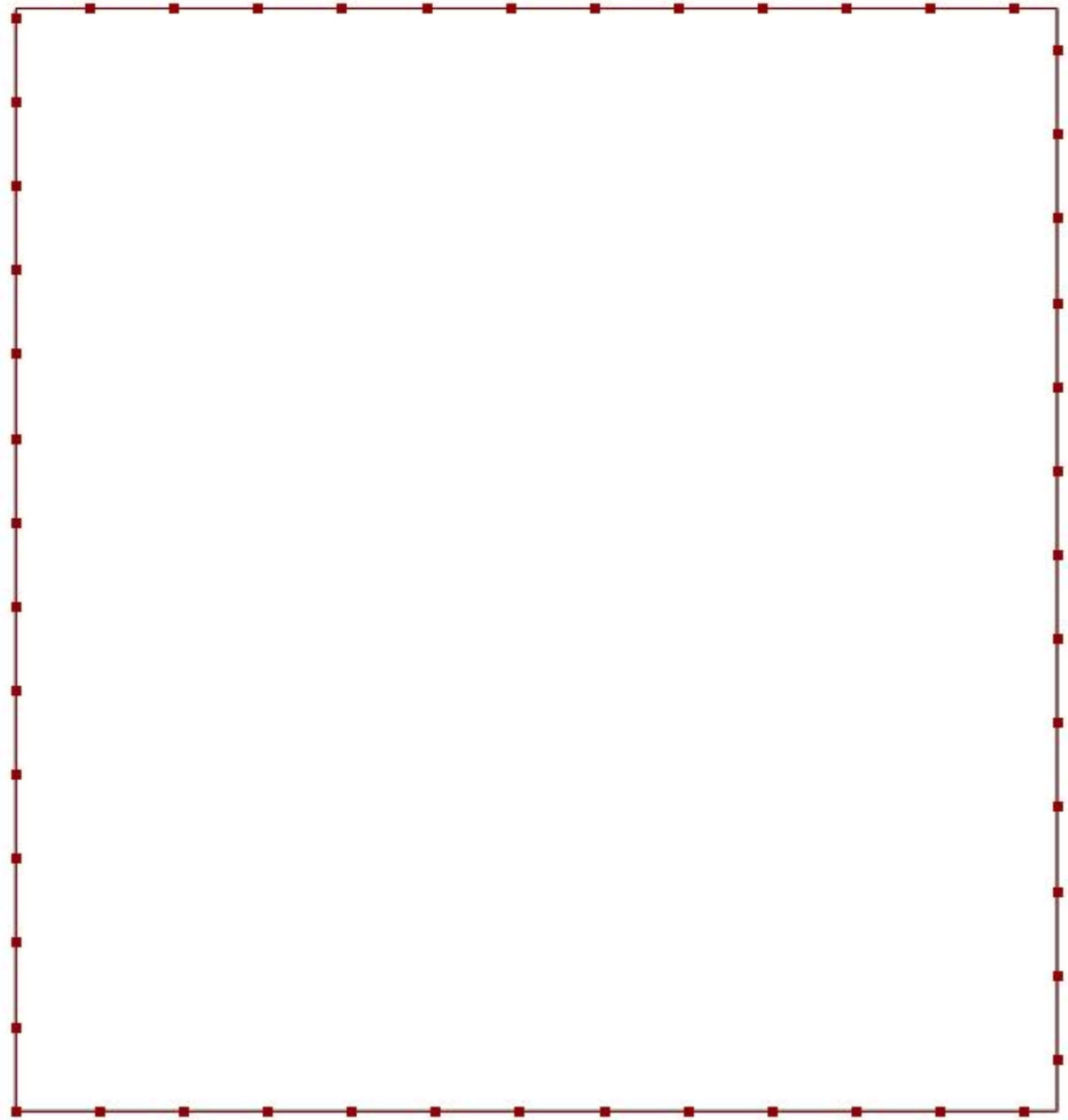


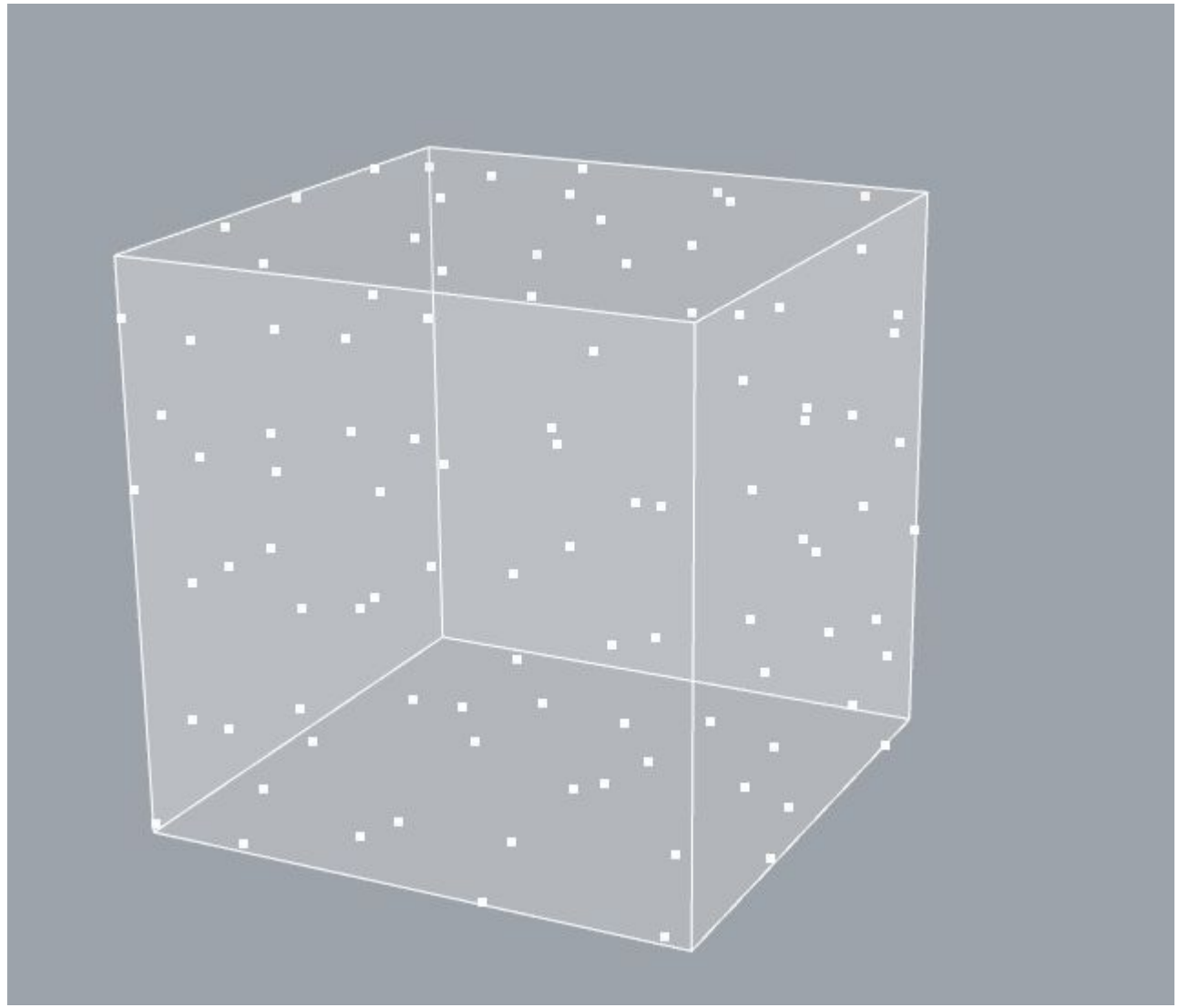
Phase 3

Each agent's path is also altered by the **influence** of the agents in the visual cone

Other agents' velocity inside the cone is averaged and applied with a reducing factor as a **steering force** to the agent

The agent is then altered in the path by the agents in the visual cone, reproducing the **storm behavior**



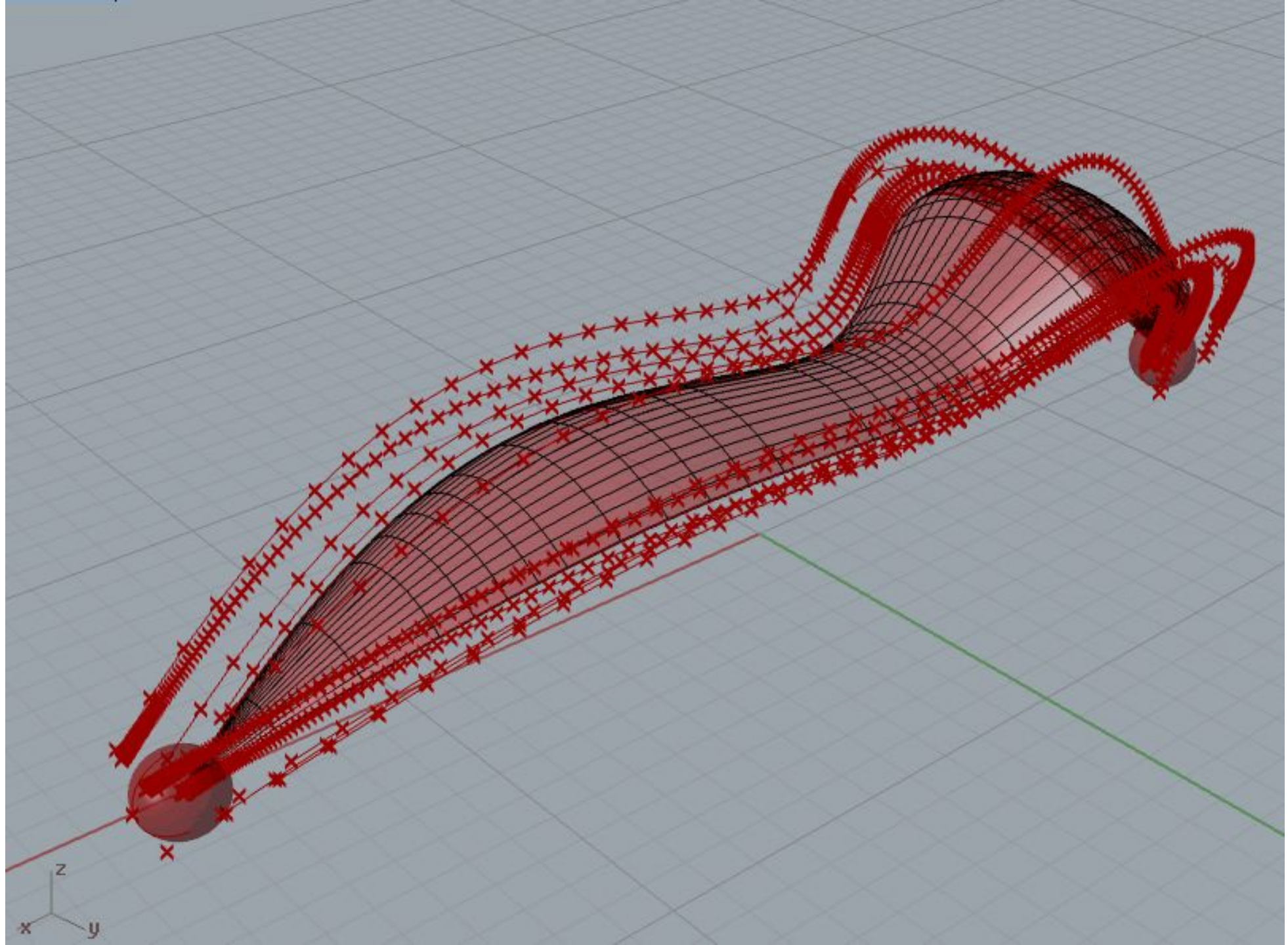


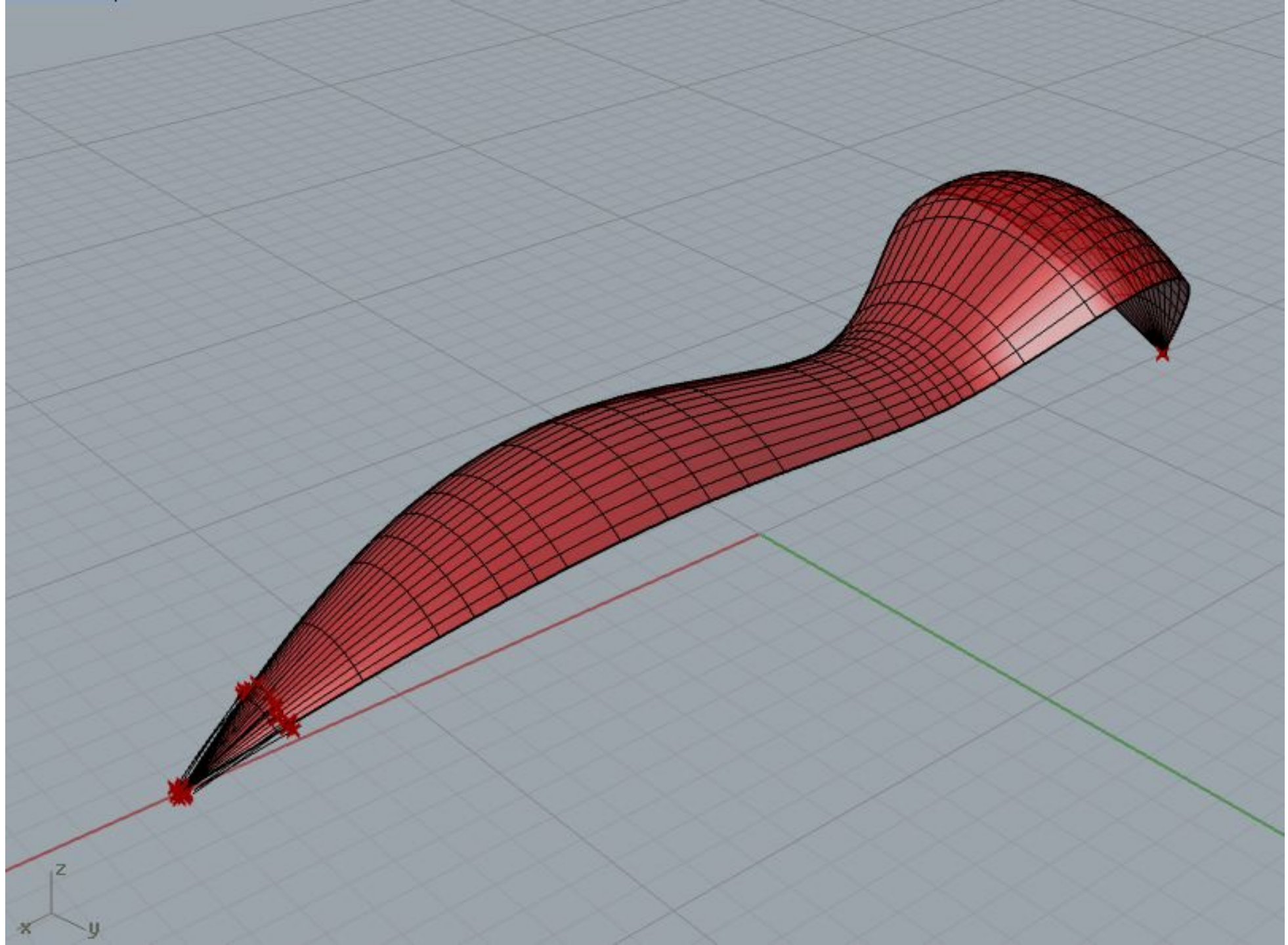
Approach 2

Phase 1

Apply the agent-based model to create a **3D surface**, conceptually seen as a lightweight steel shelter

From the structural point of view, the model is based on two sources at the base of the surface, that generate a user-input number of agents, which movement is governed by the **attraction** with respect to the opposite source, as well as the **adherence** to the selected surface


z
x
y

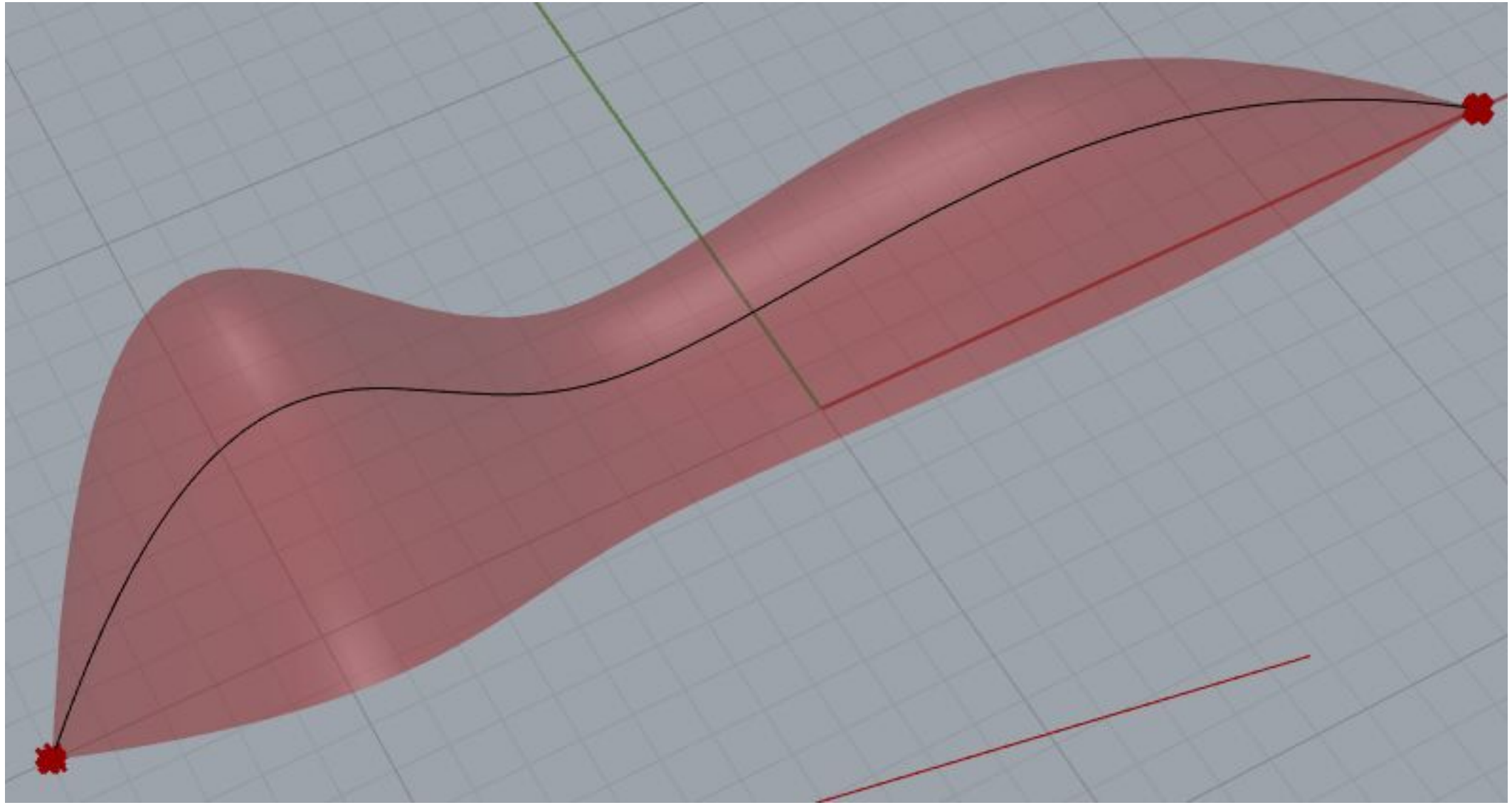

z
x
y

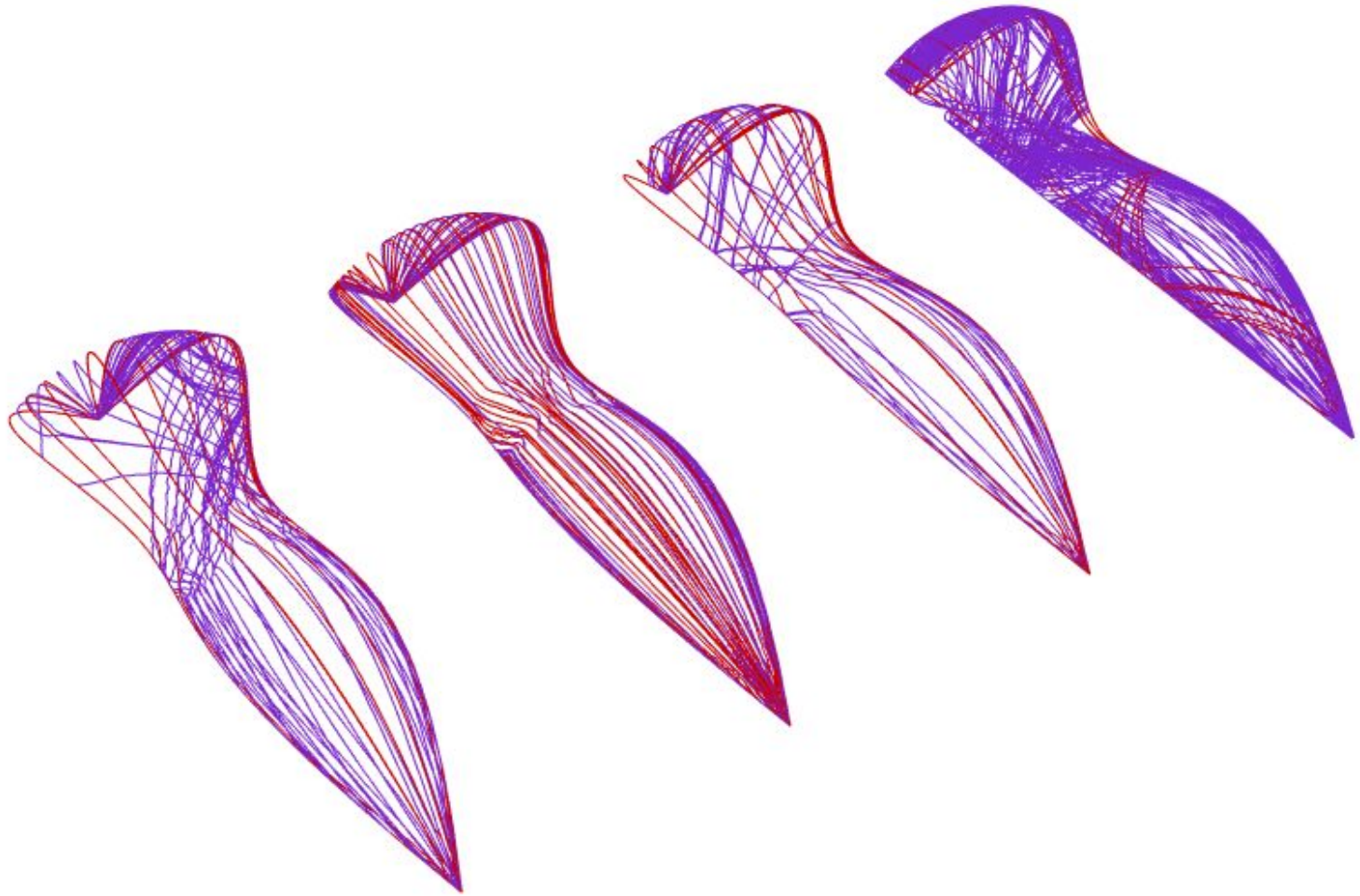
Phase 2

Differentiate the types of agents created by the two sources: one type is in charge of **model the shape** of the 3D shelter, while the other one is in charge of **model the reinforcement** of it

The first type's agents have specific **motion laws**, such as the **adherence** to the surface, the **attraction** to the other source (seen as a target) and the **repulsion** with respect to each other agent

The second type's agents differ from the previous one, as they change in motion based also on an additional **spin vector** applied

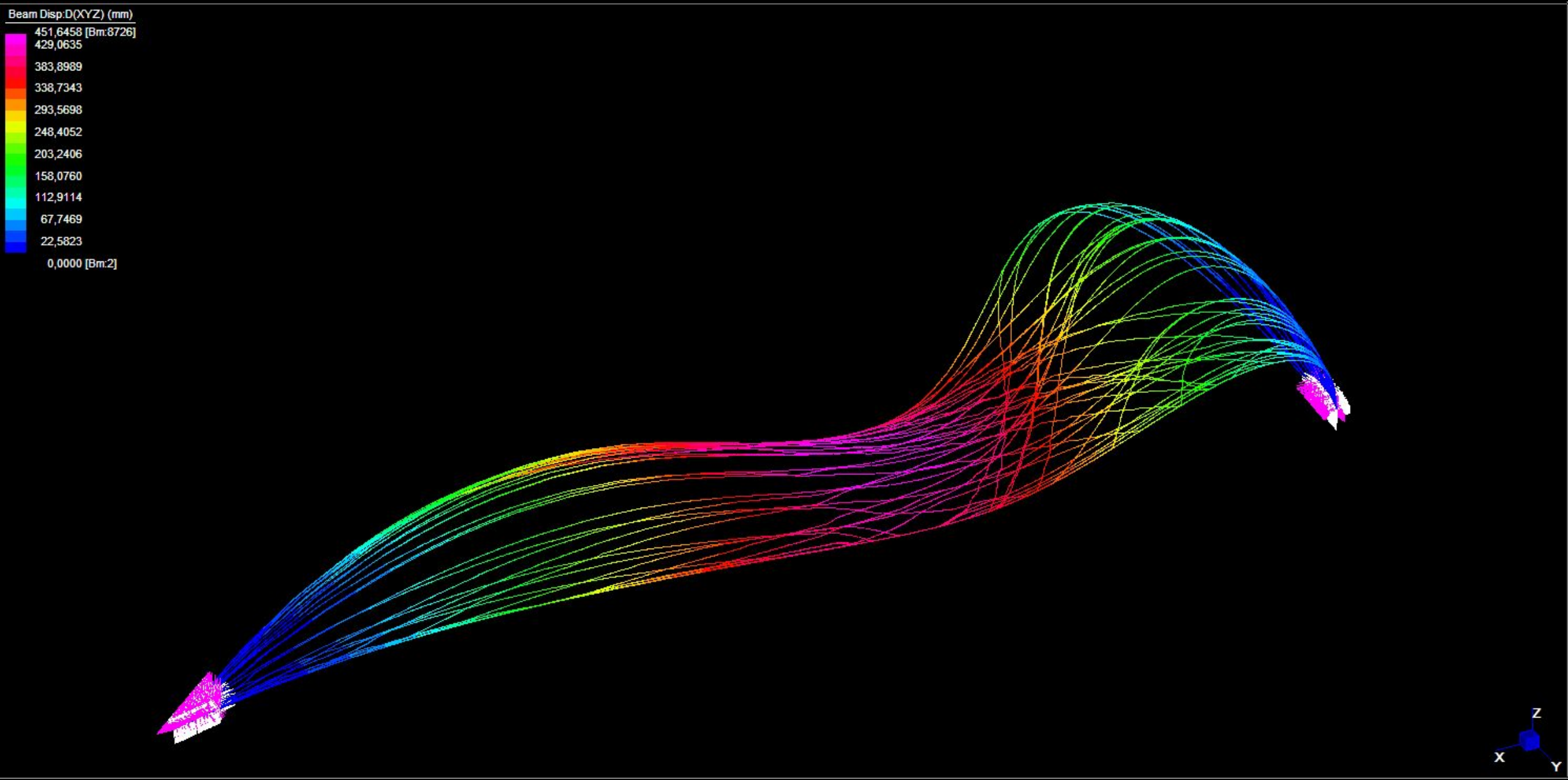




Phase 3

Structural analysis of the 3D shelter

Export the Rhino results (in terms of agents path) and import in **FEM software**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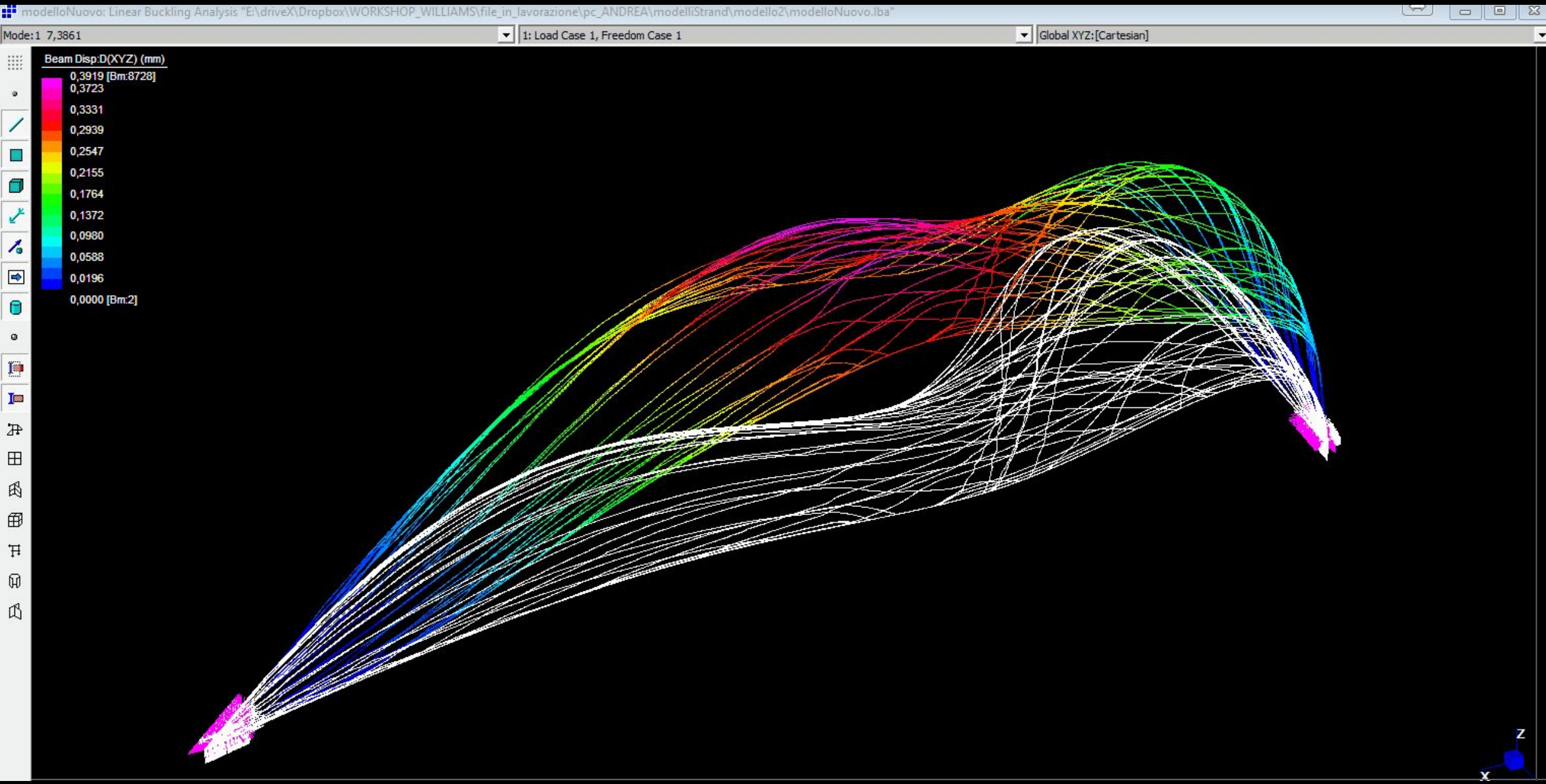
158,0760
112,9114
67,7469
22,5823
0,0000 [Bm:2]
Z
X
Y


modelloNuovo: Linear Buckling Analysis "E:\driveX\Dropbox\WORKSHOP_WILLIAMS\file_in_lavorazione\pc_ANDREA\modelliStrand\modello2\modelloNuovo.lba"
Mode:1 7,3861
1: Load Case 1, Freedom Case 1
Global XYZ:[Cartesian]
Beam Disp:D(XYZ) (mm)
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0,2939
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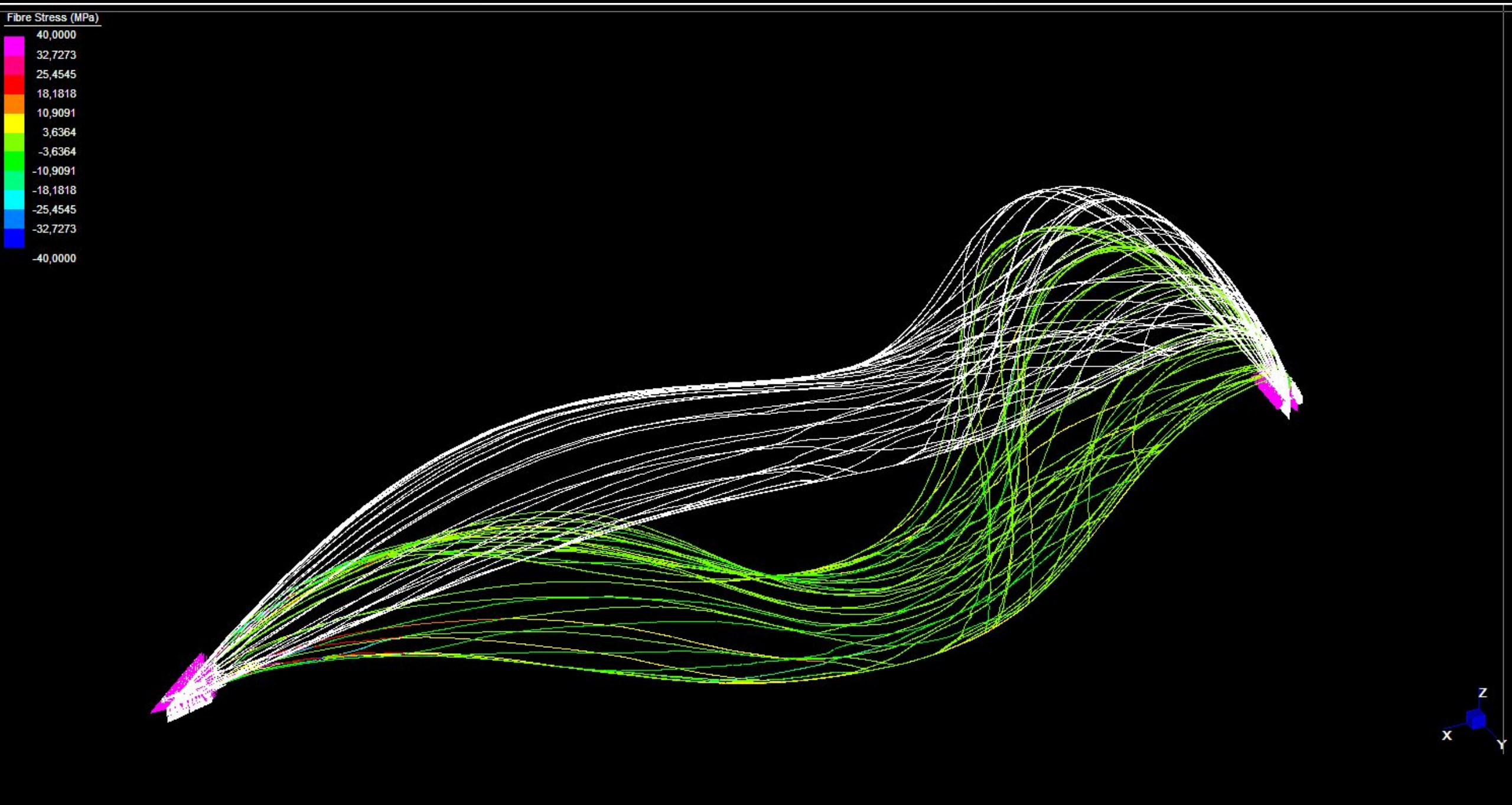
Z
X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18,1818
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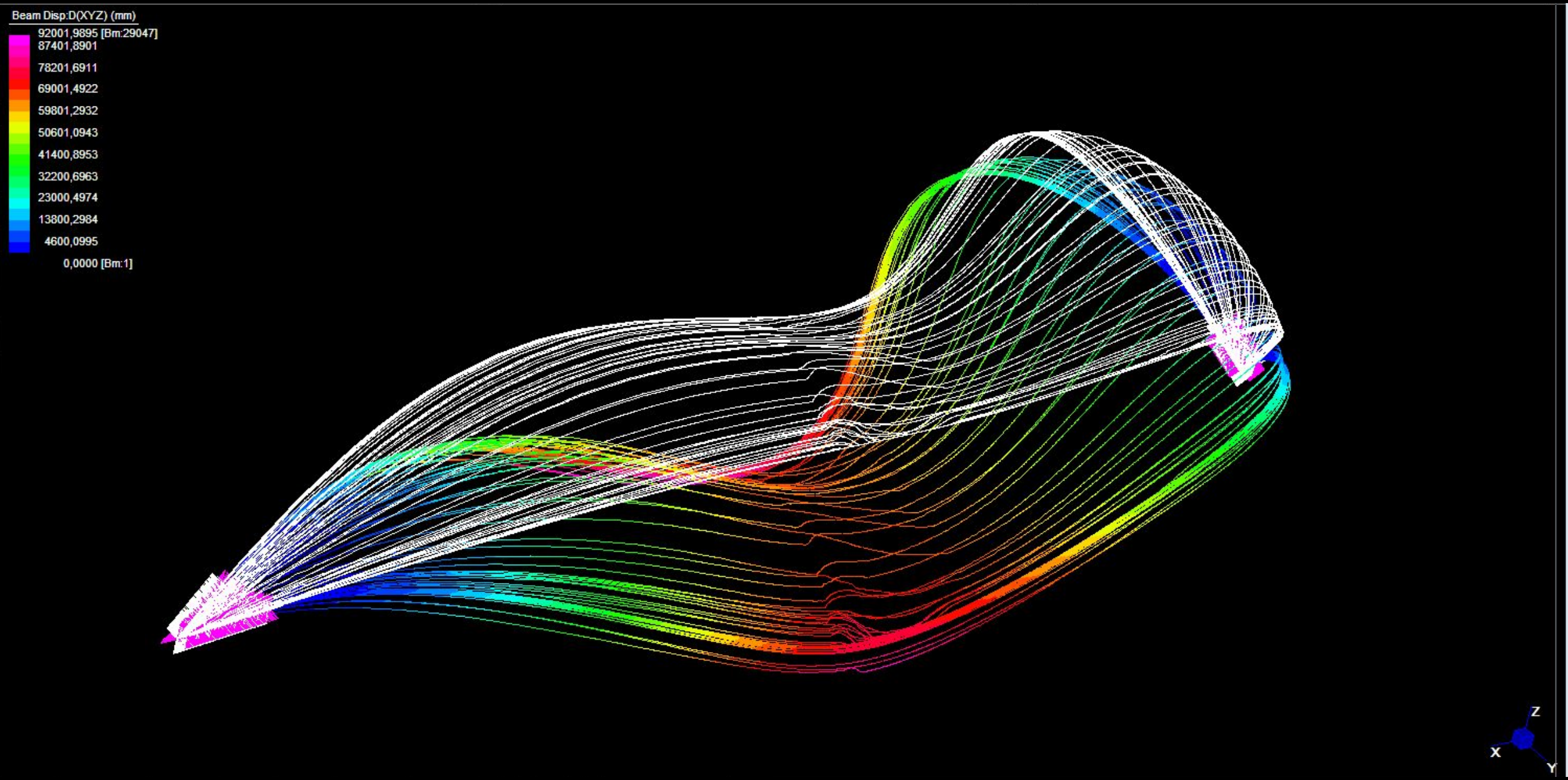
Z
X
Y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Z
X
Y