

The Visualization Method Pipeline for the Application to Dynamic Data Analysis



Skoltech

Skolkovo Institute of Science and Technology

Galkin T., Popov D., Pilyugin V., Grigorieva M.

tpgalkin@mephi.ru

Use-cases of dynamic data



Datasample A – technological data

Statistics:

Features: 11

Objects: 3809

Measurements: 128

Lines of input: 480'000

Datasample B – economical data

Statistics:

Features: 9

Objects: 81

Measurements: 13

Lines of input: 1'000



Nature of dynamic objects, 1/2

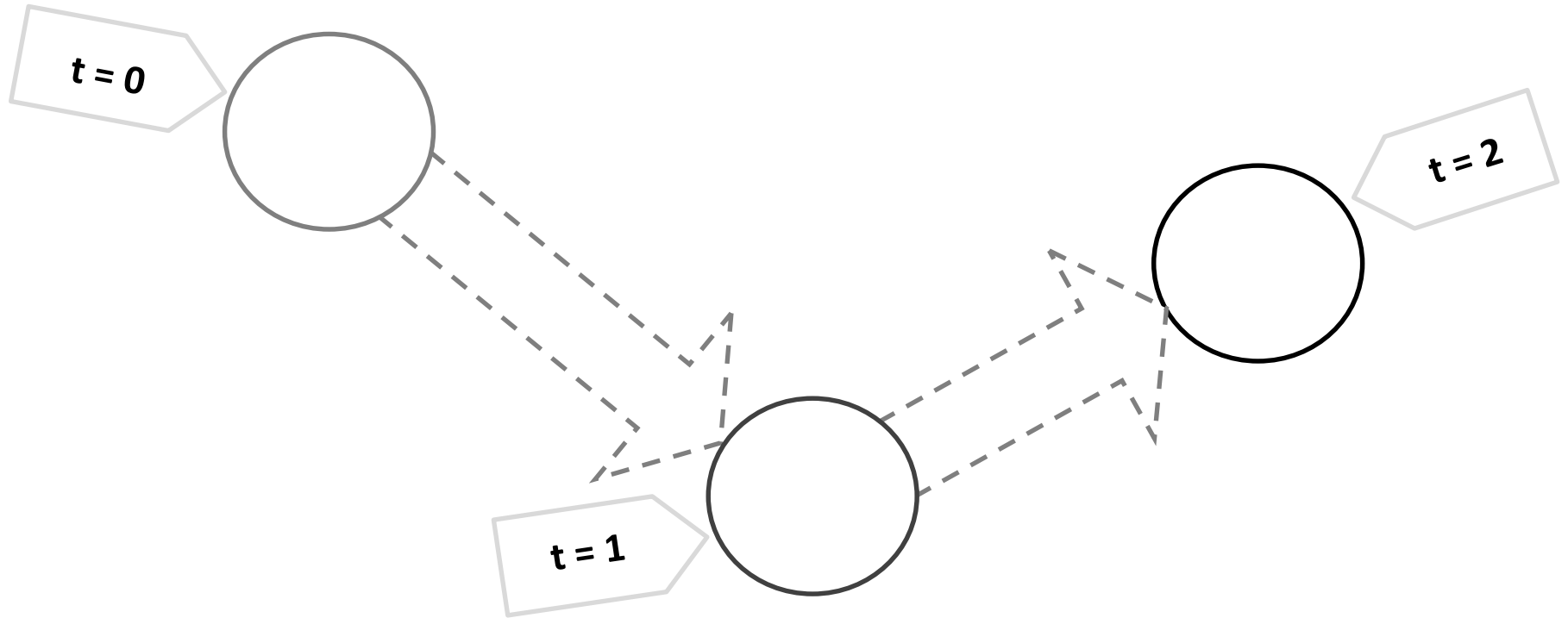


Figure 1. Dynamic object in time

Nature of dynamic objects, 2/2

t = 0		Feature 1	Feature 2	...	Feature n		
Obj	t = 1		Feature 1	Feature 2	...	Feature n	
Obj	Obj	t = 2		Feature 1	Feature 2	...	Feature n
Obj	Obj	Object 1	x_{11}	x_{12}	...	x_{1n}	
Obj	Obj	Object 2	x_{21}	x_{22}	...	x_{2n}	
	Obj	
		Object m	x_{m1}	x_{m2}	...	x_{mn}	

Figure 2. Data tables sample

Visual analysis method, 1/3

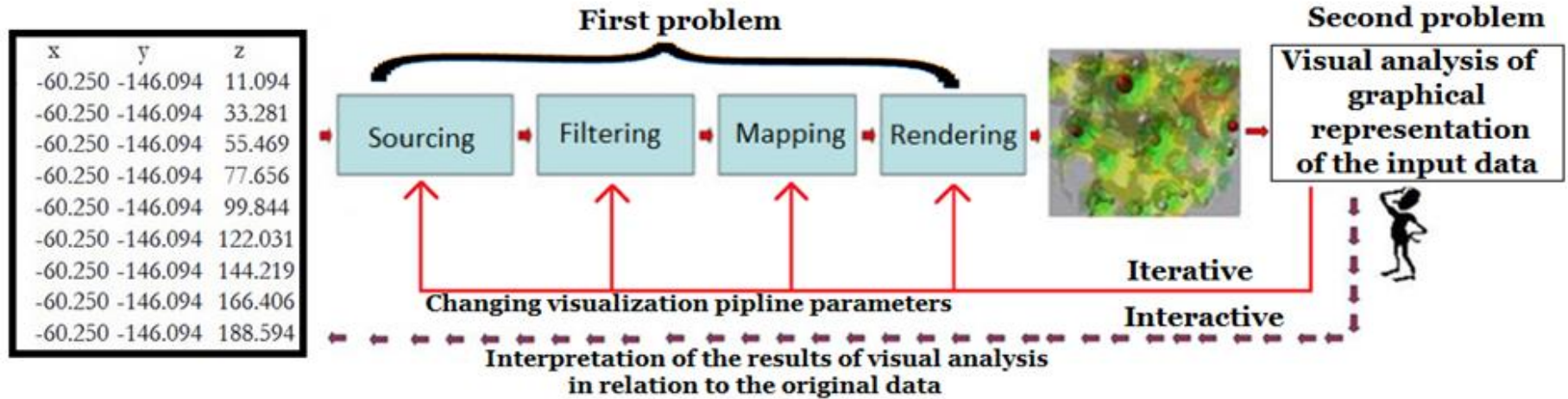


Figure 3. Visualization pipeline

Visual analysis method, 2/3

$$Cyl_{1i} = \{Red_{1i}, Green_{1i}, Blue_{1i}, Opacity_{1i}\},$$

$$Red, Green, Blue \in [0; 255]$$

$$Red_{1i} = 255 \left(1 - \frac{\rho(0, i)}{d_1} \right)$$

$$Green_{1i} = 150 \frac{\rho(0, i)}{d_1}$$

$$Blue_{1i} = 255 \frac{\rho(0, i)}{d_1}$$

$$Opacity_{1i} = \begin{cases} 0, & \text{if } \rho(0, i) > d_1 \\ 100, & \text{else} \end{cases}$$

$$\rho(i, j) = \sqrt{\sum_{q=1}^n \left(\widetilde{x}_{iq}^k - \widetilde{x}_{jq}^k \right)^2}$$

$$X = \{x_{il}^j\}$$

$$l = \overline{1, n}, i = \overline{1, m}, j = \overline{1, k}$$

$$X = \{\widetilde{x}_{il}^j\}, \text{ where } \widetilde{x}_{il}^j = \frac{x_{il}^j - \min x_{il}^j}{\max x_{il}^j - \min x_{il}^j} * 100$$

$$l = \overline{1, n}, i = \overline{1, m}, j = \overline{1, k}$$

$$P'(t) = A_{Pr} P(t)$$

$$P'(t) = \{p'_1(t), p'_2(t), \dots, p'_i(t), \dots, p'_m(t)\}$$

$$p'_i(t) = \{a_1(t), a_2(t), \dots, a_k(t), \dots, a_n(t)\}$$

$$a_k(t) = \begin{cases} 0, & \text{if } k \notin Pr \\ a_k(t), & \text{else} \end{cases}$$

Visual analysis method, 3/3

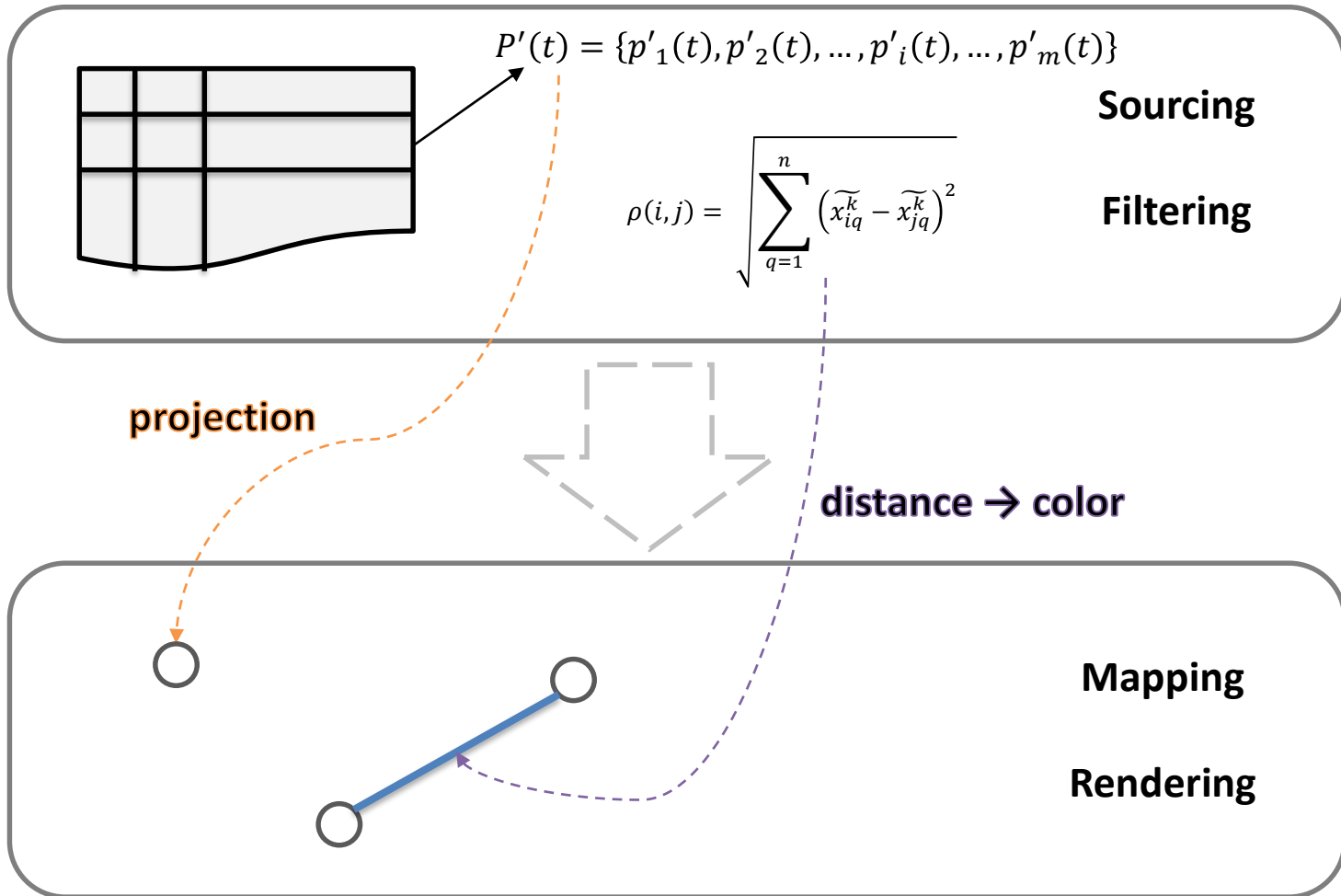


Figure 4. Visualization pipeline

Datasample A - Technological data analysis, 1/3

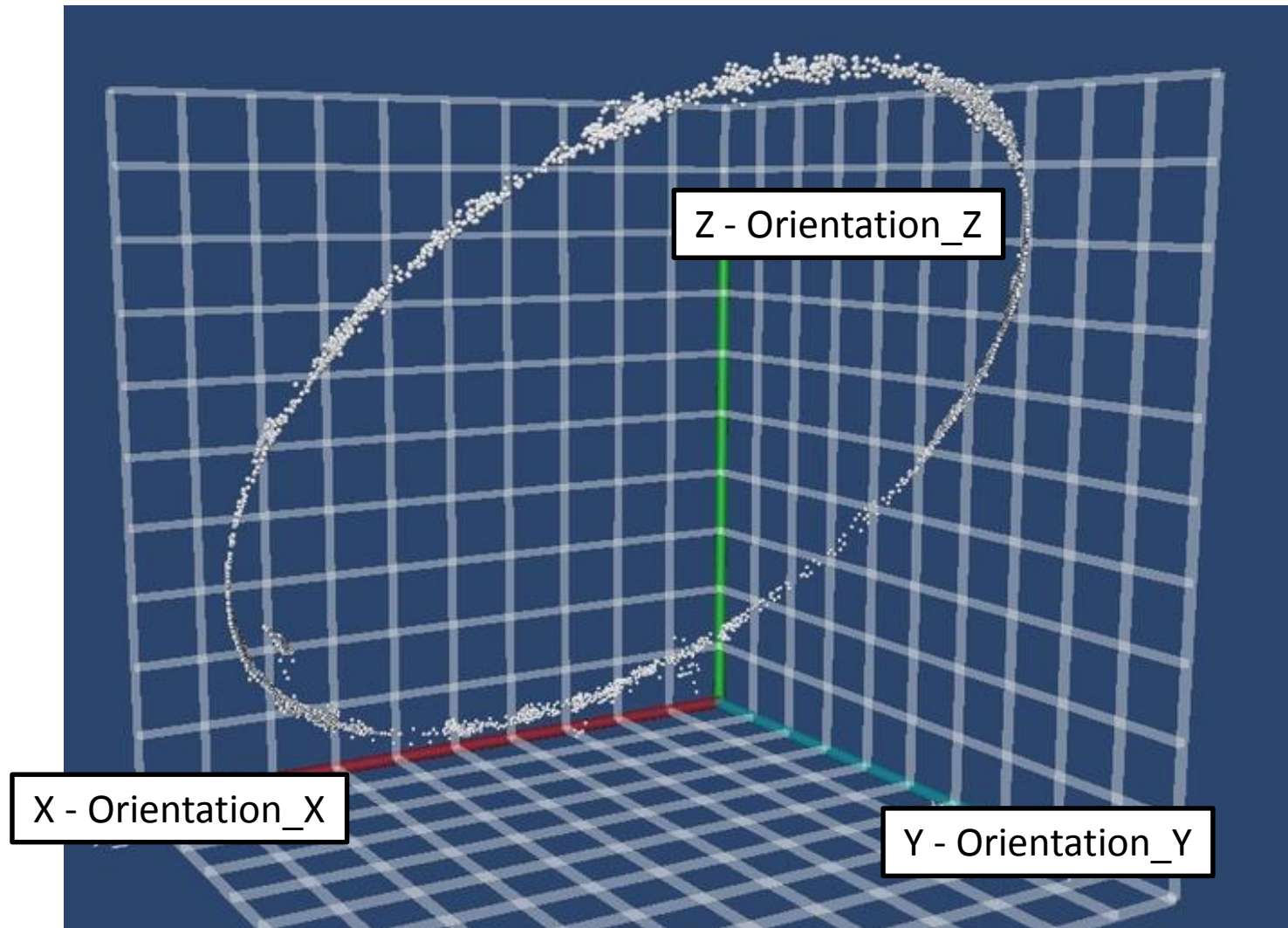
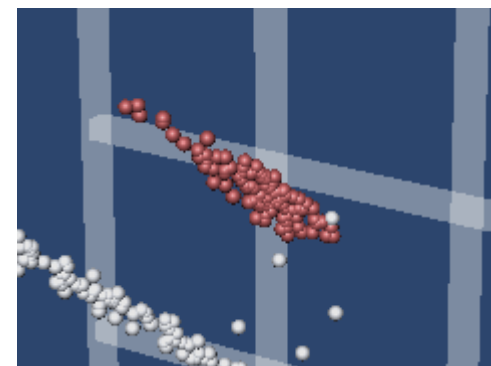
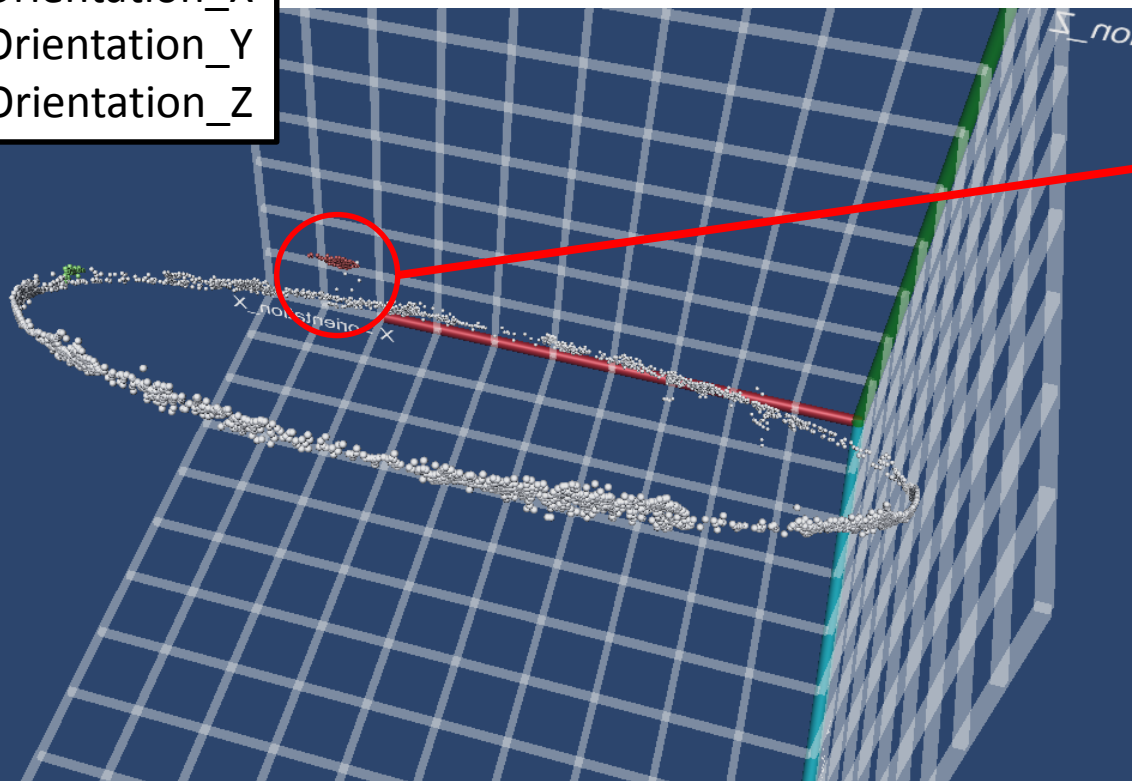


Figure 5. Technological data visualization

Datasample A - Technological data analysis, 2/3

Axes:

Orientation_X
Orientation_Y
Orientation_Z



$t = 0$



$t = 127$

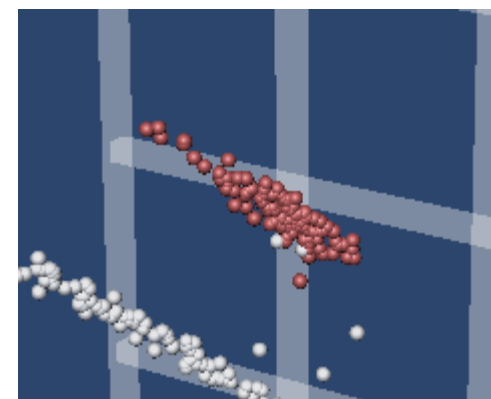
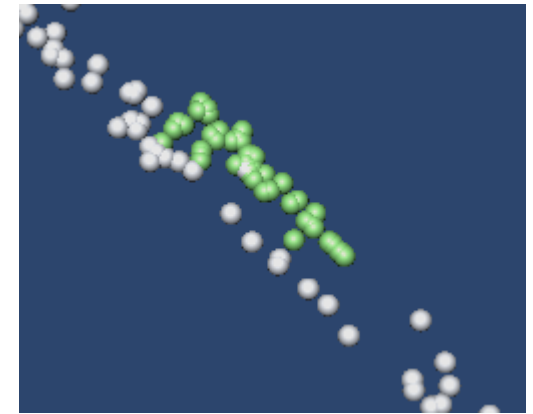
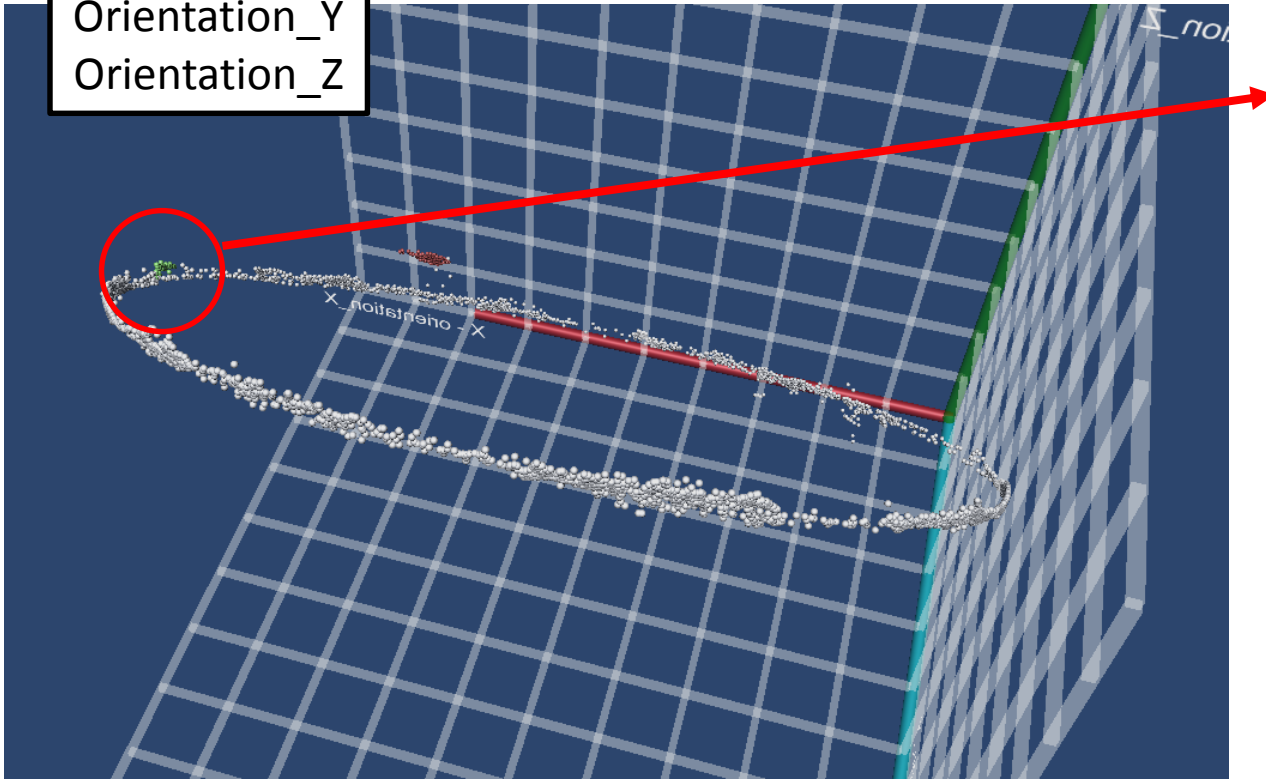


Figure 6a. Cluster 'soft_pvc' evolution in time

Datasample A - Technological data analysis, 3/3

Axes:

Orientation_X
Orientation_Y
Orientation_Z



t = 0



t = 127

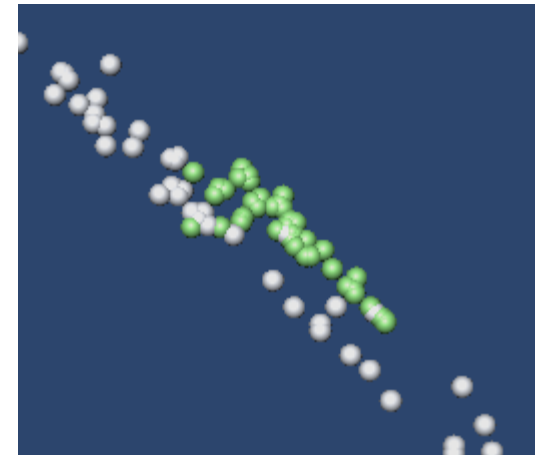


Figure 6b. Cluster 'fine_concrete' evolution in time

Datasample B - Economical data analysis, 1/3

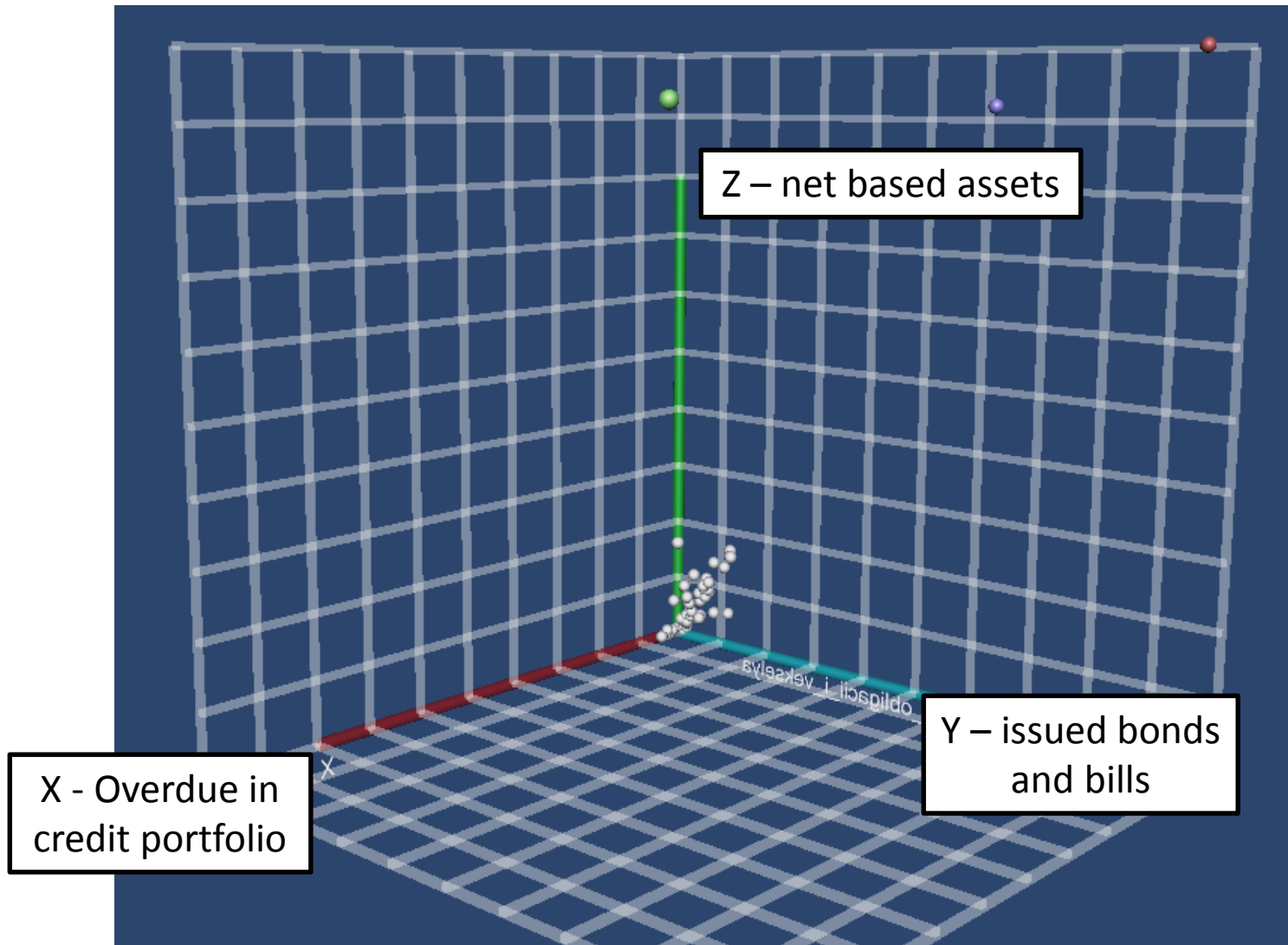
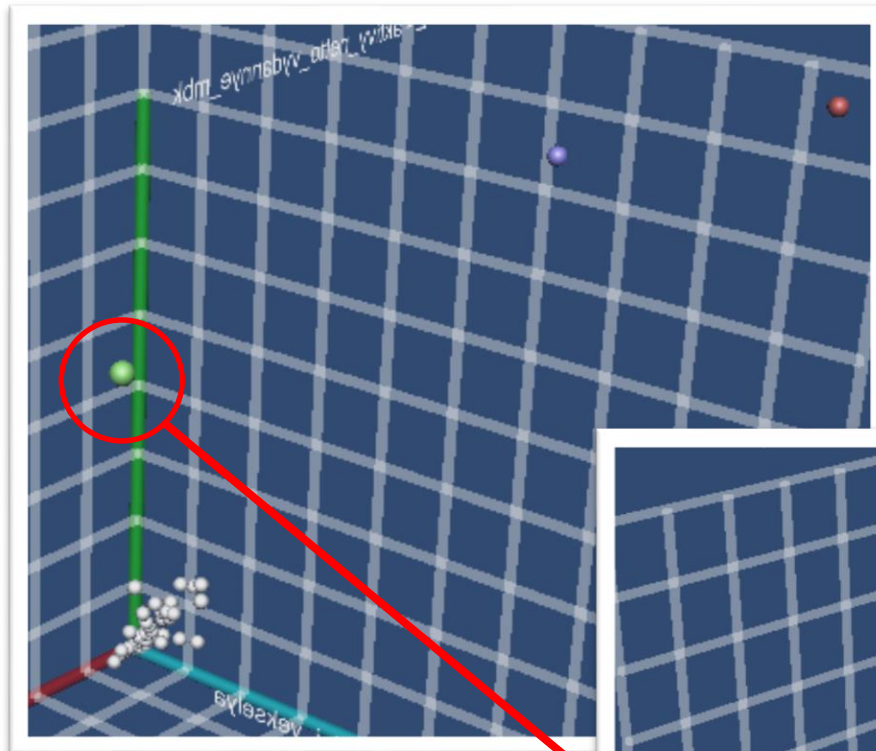


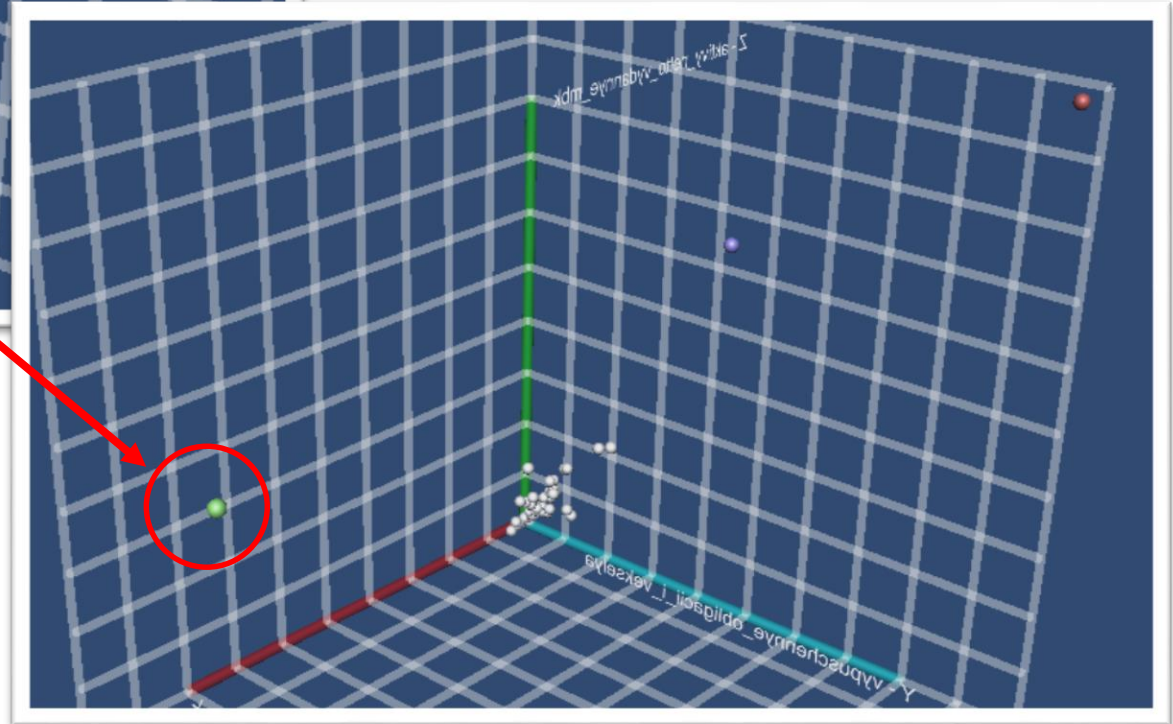
Figure 7. Economical data visualization

Datasample B - Economical data analysis, 2/3



t = 0

Axes:
X - Overdue in
credit portfolio
Y - issued bonds
and bills
Z - net based assets



t = 12

Figure 8a. Bank ID 1000 moving over time

Datasample B - Economical data analysis, 3/3

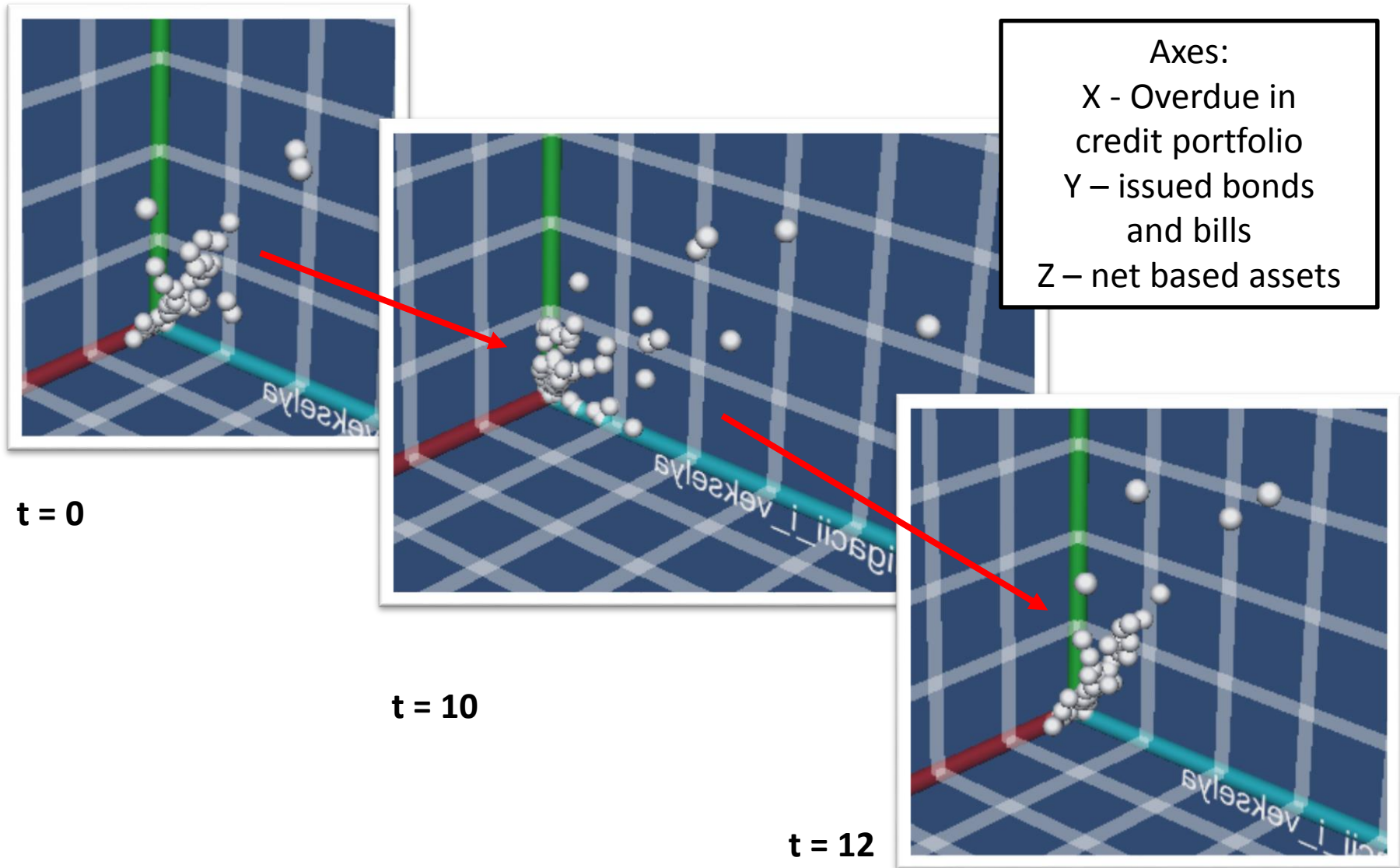


Figure 8b. Cluster at the center transforming

Application for the Nuclear Computing

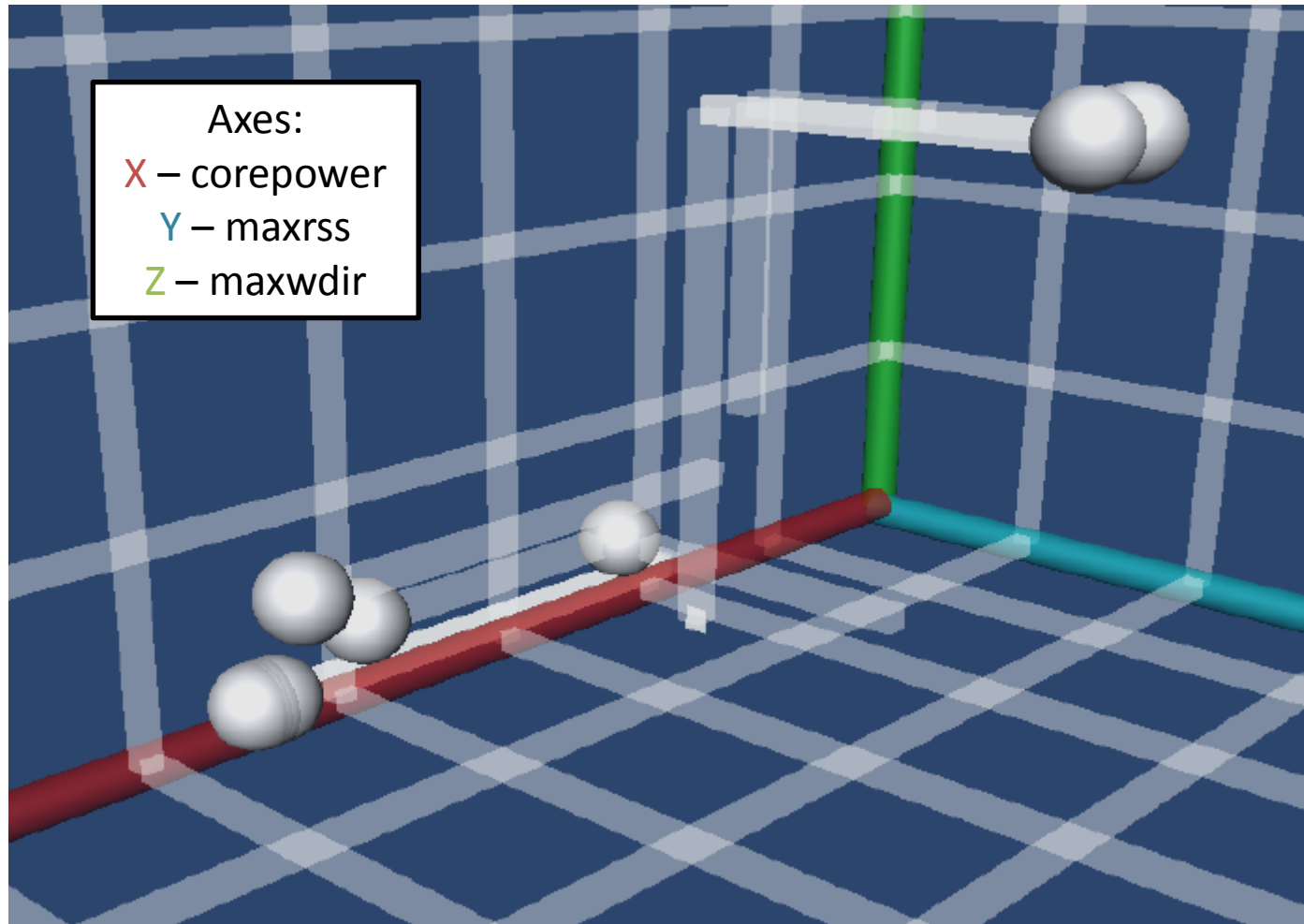


Figure 9. ATLAS Grid Information System metadata visualization

Summary and conclusion

Using the visualization pipeline, we developed:

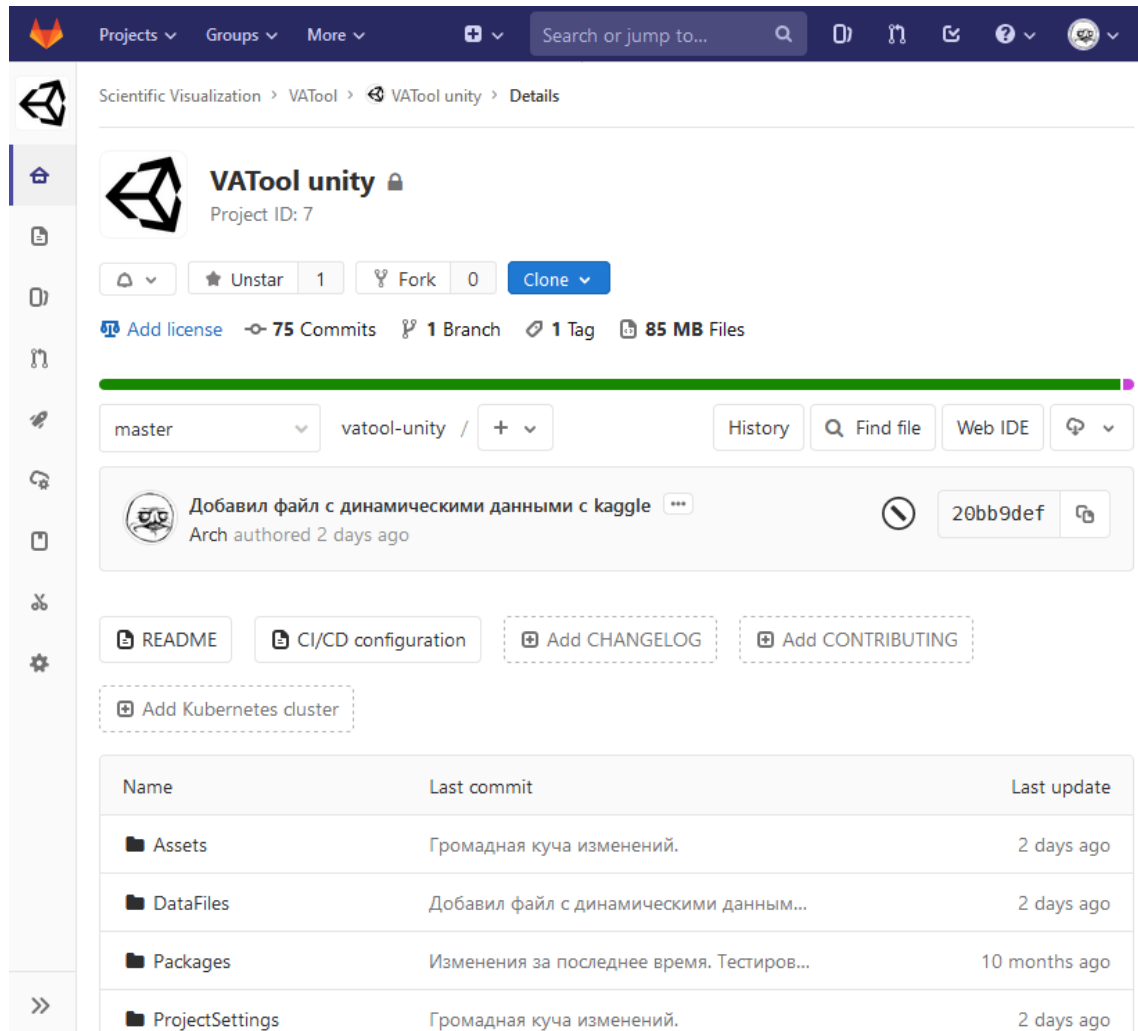
- Interactive and iterative algorithm of data analysis
- Application for the dynamic data analysis

Acknowledgements

This work has been supported by the RSCF grant No. 18-71-10003.

Backup slides

Program development



The screenshot shows the GitLab interface for the 'VATool unity' project. The top navigation bar includes 'Projects', 'Groups', and 'More' menus, along with a search bar and user profile icons. The breadcrumb trail indicates the path: 'Scientific Visualization > VATool > VATool unity > Details'. The project name 'VATool unity' is displayed with a lock icon and 'Project ID: 7'. Below this, there are buttons for 'Unstar', 'Fork', and 'Clone', along with statistics: 1 star, 0 forks, 75 commits, 1 branch, 1 tag, and 85 MB of files. A green progress bar is visible. The main content area shows a commit by 'Arch' 2 days ago, titled 'Добавил файл с динамическими данными с kaggle'. Below the commit, there are buttons for 'README', 'CI/CD configuration', 'Add CHANGELOG', and 'Add CONTRIBUTING'. At the bottom, there is a table listing project files and their commit history.

Name	Last commit	Last update
Assets	Громадная куча изменений.	2 days ago
DataFiles	Добавил файл с динамическими данным...	2 days ago
Packages	Изменения за последнее время. Тестиров...	10 months ago
ProjectSettings	Громадная куча изменений.	2 days ago



Figure A. Gitlab page