

# The Collage Authoring Environment: A Platform for Executable Publications

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## 1. Introduction

The Collage Authoring Environment [1] is a software platform which enables e-scientists to carry out research and publish their research in the form of scientific executable papers. Recent developments in both e-science and computational technologies call for a novel publishing paradigm where static content of a traditional scientific publication is to be supplemented with elements that enable reviewers and readers to reexamine the reported computational method. This includes re-execution of a method against original or user-provided data, modification and customization of a method to suit specific use case, and, ultimately, reproducibility of a method.

## 2. Description

We propose a platform which enables authors to seamlessly embed chunks of executable code and data into scientific publications and allow repeated execution of such assets on underlying computing and data storage resources, as required by scientists who wish to build upon the presented results. The Collage Authoring Environment is based on GridSpace2 Virtual Laboratory [2] that is used as an execution engine and gateway to arbitrary computational resources, including those belonging to high performance computing centers, scientific e-infrastructures and resources contributed by the scientists themselves. The platform provides access to static content, primary datasets and executable assets.

## 3. Results

The platform allowed for implementation of a number of executable papers as one depicted in Fig. 1. Every GridSpace2 experiment can be released as an executable paper by using special “embed codes” that place Collage Widgets on an arbitrary web site. The example executable paper [3] is published on Wordpress web blog platform and is backed by a dedicated installation of the GridSpace2 Virtual Laboratory [4], that is available for demo users.

## 4. Conclusions and future work

The platform on its prototype stage proved promising winning Executable Paper Grand Challenge in 2011. Since that time, additional effort has been invested in completeness and robustness of the solution. Nowadays it's delivered as a service in ACC CYFRONET AGH. Moreover, the pilot project has been launched in cooperation with Elsevier – worldwide scientific publisher, whose aim are special issues of journals featured by executable papers powered by the Collage Authoring Environment.

**Introduction**  
The grain structure of self-ordered nanoporous alumina is fundamental as it determines their applicability to what extent single entities are addressable and to what extent domain scattering affects their properties. Having SEM images of self-ordered nanoporous alumina, we can notice some pores missing, separating grains with deviating orientation. As an example for quantitative grain analysis, we use an SEM image of nanoporous alumina comparable to that seen in Asset 1.

**Method Description**  
Color Coding concept introduced in [1] is based on the assumption that the transition between adjacent grains is associated with distinct rotations of the basic six-fold motif of the pore lattice containing a central pore and six nearest neighbours. In Grain Analysis by a Spreading Algorithm central coordinates of the pores are considered to central coordinates of triangles of three nearest neighbours. The structural transition between neighboring grains is accompanied by deviations from the perfect equilateral lattice. Lattice deviations are calculated for each of the pore triangles. The spreading algorithm evaluates whether the new triangles expand the grain by sharing two corners with one of the already incorporated triangles and meet the following criteria: the deviation of angle inside the triangle and deviation of side lengths of the triangle need to be less than a given tolerance level.

**Method Implementation**

```
Snippet 1: Python 2.6.4
Code Output
def __init__(self, img):
    self.img = img
    self.pores = []
    self.areas = []
    self.diameters = []
    self.circularitys = []
    self.centers = []
    self.angles = []
    self.sidelengths = []
    self.output.write('Diameter: ')
    str(self.diam) + '\n' + str(self.diam_stddev) + '\n'
    output.write('Circularity: ')
    str(self.circ_avg) + '\n' + str(self.circ_stddev) + '\n'
output.close()
```

Area	Circ.	XStart	YStart
4193.394	0.913	172	1
2768.555	0.967	60	2
1961.816	0.926	119	2
3665.186	0.967	159	2
2422.485	0.943	311	2
2669.678	0.933	331	2
3164.962	0.898	366	2
2719.116	0.910	490	2

Asset 2: input file containing information related to pores: area of pore (column 0), circularity (column 1) characteristics, coordinates of centers of mass (columns 4 and 5).

Asset 3: Pore center coordinates: row per each pore, columns for x and y coordinates, respectively.

Asset 4: Number of pores, average and standard deviation of pore area, diameter and circularity values

Number of pores: 1204  
Area: 2719.40362468 +- 517.664866474  
Diameter: 56.8420595265 +- 20.6712153627  
Circularity: 0.93369269105 +- 0.037078827772

GridSpace? You're logged in as **pligcapien**  
All assets loaded

Fig. 1. Example on-line executable paper (fragment): “Implementation of Algorithms of Quantitative Analysis of the Grain Morphology in Self-Assembled Hexagonal Lattices according to Hillebrand method” [3]. Web page content is enriched with Collage Widgets that enables interactive execution of computations and insight into experiment input output files.

## References

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3. E. Ciepiela, L. Zaraska, G. D. Sulka: Implementation of Algorithms of Quantitative Analysis of the Grain Morphology in Self-Assembled Hexagonal Lattices according to Hillebrand method, example executable paper powered by Collage, <http://gs2.cyfronet.pl/epapers/hillebrand-grains/>
4. Dedicated instance of GridSpace2 Virtual Laboratory provided by ACC CYFRONET AGH, <https://gs2.cyfronet.pl>