

# LITERATURE REVIEW 1

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## Primary Paper: Distinctive Approaches to Computer Graphics Education

Link: <http://onlinelibrary.wiley.com/doi/10.1111/cgf.13305/full>

This paper explained educational experiments that faced problems in Computer Graphics education. Those problems are connected to the following things:

- 1) arts and how to familiarize in CG oriented technical courses,
- 2) whether a visualization course in game development is helpful or not
- 3) function of research-oriented events in undergraduate CG programs.

Computer Graphics and related fields are expanding and evolving, designing and maintaining appropriate and updated curricula, as well as teaching methods is more and more challenging and should be approached as a continuous research activity. Section 'CG and Animation Undergraduate Research Projects' provides insights into an undergraduate research course for final year undergraduate students embedded in a UK undergraduate degree programme in the CG, animation and effects field. Section 'Research Seminars in Undergraduate Programme' gives an overview about the Central European Seminar on Computer Graphics (CESCG), an annual scientific seminar for undergraduate students of visual computing having as main mission to promote CG research and to motivate students to pursue academic careers. CG penetrates into many activities of everyday life and new for artists. Whereas CG students at CTU are taught in a varies other ways to create graphics software. This helps them to broaden their skill set and also provides them with a key insight into art. This is included in a BSc programme where students are early acquainted with artistic ways of creation in order to apply this skills to their further education in various Computer Graphics courses included the Master of Sciences programme.

The modern approach used in the Art and Graphics Design course is based on the concept of immersion into art. The two major components are:

- 1) 'Forcing' CG students to feel and think like artists during the creation of a piece of art.
- 2) Giving them a basic idea regarding the concept of art in general.

The whole picture is actually based on a hypothesis that creative processes are of universal nature regardless of whether the work of art is created using traditional means (pencil, brush, chisel, etc.) or by some tools based on Computer Graphics technologies. The process of drawing may be characterized as the transformation of a 3-Dimensional information to a 2-Dimensional.

The course from the paper was always weighed very clearly. This was always in the top 5% in the list of all courses offered at Faculty of Electrical Engineering. In total, 700 courses were evaluated each semester. Such an intensive, one semester course is very time-efficient compared to extensive study programmes in which the topic (artistic creation) is spread throughout several courses. The current form of the course is a result of several years' effort in which a good balance among the individual components of the course was achieved. This course is part of a 5-year degree at Blekinge Institute of Technology (BTH) and was created due to the increasing importance of visualization theory and practical knowledge about visualization tools in the area

these students are going to be working in. The Research and Development oriented Collaborative Research Project is a mandatory research course that students are supposed to do in the first semester of the third year of the BSc Software Development for Animation, Games and Effects (SDAGE) programme of the National Centre for Computer Animation (NCCA) in Bournemouth University's Faculty for Media and Communication.

A positive side effect, apart from benefiting students in terms of learning and professional development, is that engaging undergraduate students with the type of research more commonly encountered in postgraduate research programmes. This further engages the high achieving students that would otherwise disengage due to a lack of challenge and therefore serves as a complement to the usual educational practice of improving the learning of weaker kids. The greatest strength of the CRP course is that it engages undergraduate students in the type of research more usually experienced at postgraduate level. The CESCg is an annual scientific seminar for undergraduate students of visual computing from all of Europe. During 3 days, students from about 15 universities present their first scientific research to an audience of approximately 80 students and professors. Growing interest of other research groups inspired Helwig Hauser and Andrej Ferko to organize an international conference-like event for undergraduates.

**Schedule and organization during the year** Any university or research Centre can participate at CESCg with their BSc and MSc students. Partner institutions nominate talented students for the seminar 3 months in advance. Since 2015 the seminar format changed, with new features adding more interaction and dynamics. Opened by a fast-forward session of students and industry partners, the first day is focused on fascination by visual computing. This motivates students to prepare the material for the seminar in the best possible way. In the morning the workshop is presented. Students learn about a general talk structure and interaction with the audience. On second day, there are story telling workshops. There students learn about the structure of scientific papers and presentations.

CESCg is proved to be very very successful in connecting professors with their future PhD students. But unfortunately, if they invest too much effort and reach a certain quality, they skip CESCg and submit directly to a peer-reviewed journal or conference. Some of the participants from the early years are now professors sending their students to the CESCg to form the next generation of visual computing researchers. The undergraduate CRP in CG and animation of the NCCA provides students with skills to be able to develop a software artefact solving a CG research problem. Maintaining relevant courses for teaching CG, in the light of these novel and emerging applications, is a key challenge for future research in CG education.

## Secondary Paper: Real-Time Fluids – Optimizing Grid-Based Methods

Link: <http://www.ep.liu.se/ecp/120/015/ecp15120015.pdf>

This paper is related to the primary paper in a way that this paper as got grid based methods which we discussed in the primary paper. Although primary paper not only focuses on grid based methods but also on other methods, yet the secondary paper completely focus on the optimizing of grid based methods.

Most existing methods focus on offline simulations, where the quality is more important than the speed of the simulation. Traditionally the methods to simulate fluids for real-time applications can be distinguished into two main categories: Eulerian methods, which are based on the calculation over a discretized simulation space and Lagrangian methods, which are particle-based. At the core of Eulerian methods is a fixed space subdivided by a regular grid where the parameters of the fluid are calculated per cell, where one needs to find a balance between the quality of the simulation and the resolution of the grid. To increase the performance of fluid simulations based on a regular grid, they are proposing to isolate the cells that contain dynamically changing information and perform the simulation only on these cells. There exist a number of physically-based approaches for fluid simulation.

The gridbased Eulerian approach as presented by Stam lends itself particularly well to the real time simulation, as the fixed size of grid cells greatly simplifies the simulation step. In grid-based fluid simulations a regular grid of a fixed size enclosing the simulation area is used. At setup of the simulation, the grid cells are initialized to hold the initial values for the fluid parameters, and at each simulation step, changes to the cells will be calculated using the Navier Stokes equations.

The type of adaptive grid structure employed by these approaches may not be ideal for use in the real-time fluid simulation, as Kallin suggests that a dynamically changing adaptive grid might be too computationally expensive. On the first step they find which cells from the given regular grid participate in the simulation, for example those that carry non-zero density parameters of fluid. The boundary of the grid allows us to find the bounding volume of the simulation and to process only neighboring cells of cells isolated on the boundary during the next step of the simulation. Then On the second step they find the cells inside the simulation area that have identical or similar parameters. And Finally they calculated the simulation step and update the surface flag cells that become relevant or lose relevance to the simulation. The very same step allows us to identify the areas with similar parameters to set the participation flag for the next simulation step.

Initial results for two simulations using a 400x400 grid and running on a 64 bit Linux based machine with 8 Giga Bytes of RAM and an Intel Xeon E5-1650 CPU - the first simulation implementing a conventional grid-based fluid simulation, the second adding the improvements

to this simulation - showed that in the worst case the performance of this method was no worse than the conventional simulation, fluctuating between 5 and 7 frames per second. The same set of simulations running on a 64bit Windows machine with 4GBRAM and an Intel Core i5- 2450M CPU achieved a similar performance, with the conventional case as well as this method's worst case achieving on average 4.5frames per second.

As the evaluation of the surface/participation flag for each cell effectively cells do not contribute to the simulation, in simulations where the fluid does not fill all of the simulation space there is a noticeable improvement that this method achieves in the terms of processing time, when compared to existing methods. The worst case when the fluids extend to the completion of simulation area and then all grid cells contribute to the simulation, meaning that the additional queries would have no effect and no longer need to be performed. And therefore this method will also achieve the same level of performance as compared to the existing methods.