Russia: Computer Graphics Education Takes Off in the 1990s

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This paper is the first attempt in analyzing the history and the state-of-the-art of computer graphics (CG) education in Russia. Since this collection of information has just begun, the resulting picture is necessarily incomplete.

Background: Organization and Pursuit of Education and Research in Russia

There are some cultural features that strongly influenced the formation and development of computer graphics education in this country. Perhaps the most important feature is that education and basic research are separated. The university system is controlled by the Ministry of Education, and institutes oriented exclusively toward research are subordinated to Russian Academy of Sciences (RAS). However, the separation is not absolute. Some research projects are conducted in universities, and post-MS education is available in institutes of RAS. Moreover, scientists from RAS are often part-time professors in universities or sometimes even chair holders (heads of labortories).

Education in universities takes five years (six years in the engineering disciplines), and it is concluded by defending of diploma work or a project (like a master thesis). There is no an intermediate degree like B.Sc., B.Eng. Post-MS education takes three years, and it is completed by defending a candidate dissertation (like a doctoral thesis).

There are three stages in undergraduate university education: general disciplines for the first two years, then specialization within a selected chair for two years, and finally one year for completing research and writing a thesis. After choosing a specialization, a student chooses an advisor who defines topics for course work and theme for the master's thesis.

For example, more than 1,500 undergraduate and graduate students (about 300 per year) study at the Department of Computational Mathematics and Cybernetics at Moscow State University. The department is subdivided into chairs (laboratories). One of the chairs, which gives a specialization in computer graphics (along with computer architecture, parallel processing, and some others), accomodates about 120 third to fifth year students. About 30 of these students are specializing in computer graphics and image processing. About 10 students per year defends their diploma works in these areas.

Formation and Development of CG education in Russia

CG research and education in Russia have come into being under quite unfavorable conditions: isolation from western countries, rather weak contacts with western professionals and professional societies. COCOM regulations made to produce and use almost exclusively domestic computers and develop domestic software for them.

Even then, the window was not completely walled up. Soon after the book *Principles of Interactive Computer Graphics* was issued in Russian in 1976, one of the authors, Prof. W. Newman, visited Moscow. A short time later, **Prof. J. Bresenham** also visited. I attended the Spring Joint Computer Conference (SJCC) in 1971 and had already been a member of the ACM for one year at that time - probably the first Russian member of the ACM. The library of Keldysh Institute contains a set of Communications of the ACM journals from the very first issue and many SIG newsletters (including *Computer Graphics*) since 1976.

The first developments in CG date back to the second half of the 1960's. They began in institutes of RAS (Moscow, Novosibirsk) in order to provide facilities to visualize results of scientific computations. At the same time languages for description of drawings were devised in Minsk and Nizhny Novgorod. At the beginning of the 1970's, a CG theme appeared in several master's theses. By the middle of the 1970's, several doctoral dissertations had been defended. Since then, computer graphics had been recognized as an educational subject.

Several CG courses were given for professionals during the second half of the 1970's. Notice that the book by Newman and Sproull appeared in Russian in 1976. It defined the structure and content of the courses and was used as a textbook. Our experience in creating of domestic graphic systems was also included in lectures.

CG courses have appeared in university programs since the beginning of the1980's. CG course has been given in Moscow University as a two-semester elective since 1983. Untill 1990, 20 to 30 third and fourth year students attended the course. Weekly seminars are also conducted for those who have chosen CG as their specialization . Students report their own results of research works, and they review papers from SIGGRAPH conferences proceedings, *ACM Transactions on Ggraphics*, *IEEE Computer Graphics & Applications* and other sources. They proceed their study for two years, entering step by step into research, and finally complete their education defending their diploma work.

Around 1990, the interest in CG courses among students was dramatically increased. More than 100 students attended lectures. Consequetly, a one-semester "Introduction to Computer Graphics" course became a required course for about 300 students. In addition, a one-semester advanced course is given as a professional elective.

CG courses are somewhat different in different universities. However textbooks by Foley&van Dam and by Rogers are commonly used, and they they unify various approaches to some degree by providing a common educational foundation.

In engineering programs, computer graphics can be found as a part of descriptive geometry, drafting and CAD/CAM courses. This part is frequently connected with learning some foreign (e.g. AutoCAD) or domestic system to perform drawings with the help of a computer.

Social Aspects: Current State of CG Education

The situation changed dramatically upon entering the 1990's. The Cold War was over, and COCOM's restrictions were removed. An absolutely new problem - integration into the international professional community - came up after many years of isolation. Franco Preparata, in his preface written in 1988 for Russian edition of *Computational Geometry* invited colleagues from the Former Soviet Union (FSU) to join in honest and fascinating competition in the field. (The development of computational geometry was considered a competition among researchers and at that time, no Russian work was internationally known in this area.) This invitation became (non-virtual) reality. But the new reality meant that many principles and approaches previously used in CG education would have to change.

It so happened that at this turning-point, the GRAPHICON'91conference was held, partially supported by ACM SIGGRAPH. It was an extremely impressive event with 3,000 participants (from 106 towns of FSU). The impact of the conference extended far beyond the area of computer graphics and is still felt. One French journalist suggested that social significance of the event was even higher than its technical or educational content. In fact GRAPHICON'91 was not the first CG conference in Russia, having been preceded by five nationwide biannual meetings. However, GRAPHICON showed the way for international cooperation, not only in computer graphics but in computer science in general.

On the eve of GRAPHICON'91, a paper "ACM SIGGRAPH and Computer Graphics Education in the United States" by Steve Cunningham appeared in the journal *Programmirovanie*. Later an account of ACM/IEEE-CS Computing Curricula 1991 was given in the same journal. Roundtables and/or seminars for educators have been organized during subsequent annual GRAPHICON conferences. (The sixth one was held in July 1996). The conferences became an important means to promote and coordinate CG education in this country. In addition, they are an important source for up-to-date publications to compensate the acute shortage of professional literature that has arisen in Russia during recent years. The textbook by D.Rogers was the last text on CG issued in Russian, and that was in 1989. The partial list of textbooks below shows when they were published in Russian. Another text by Rogers and Adams, translated into Russian about five years ago, is still not published. The aforementioned library of Keldysh Institute discontinued its subscription to *CACM, ACM TOG, CG,* etc. in 1992 because federal R&D and education funding was greatly curtailed. The first attempts to overcome this information blockade have been undertaken. Two domestic books on computer graphics have recently appeared, one of which is based on CG courses in Moscow State University.

The difficulties we have encountered are not specific to computer graphics. They are the same for computer science and for R&D and education in general. However, they are social at most. I am sure that deeper cooperation with ACM SIGGRAPH can alleviate some of them.

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