control polygon $V_0,V_1,...,V_n$ and by two sets of shape parameter values $\bar{\beta}1=(\beta_{1,0},...,\beta_{1,n})$ and $\bar{\beta}2=(\beta_{2,0},...,\beta_{2,n})$. The general matrix of the β–spline curves was founded and the special causes were distinguished according to choice of the value of the shape parameters. The matrix expressions are suitable especially for hardware generation β–splines curves.

References

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Computer Graphic Hardware
(Conditions and Experience from Teaching Courses)

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Selected courses on Computer Graphic Hardware at our Department of Computers, Electrical Faculty of Czech Technical University in Prague are attended by 15-20 computer graphics students every year. Sometimes also students interested in other fields take a part in this class.

The course was taught in the winter semester of the 5th study year in the past; since 1993/94 school year it is taught earlier, in the summer semester of the 4th year of study. The idea behind is to give students information how to implement algorithms of computer graphics, including parallel ones, more efficiently. So the main orientation is not towards designing the HW.

Considering the fact, that implementation tools are relatively complex and there is only limited amount of them available, it is not possible to organize the classes in the laboratories for a whole study group. The solution for this problem is, that students take a part in particular course projects, depending on their interests and orientations. The results are published in course colloquias.

As it will follow from the overview below, our HW implementation tools do not cover all the course fields. There is a lot of topics which are taught only theoreticaly. Our opinion is, that it is neither possible nor expedient to let the students experiment during the course time with all the equipment and

methods. Our approach is oriented mainly to develop their ability for interdiscipline links and to solve relatively complex problems in this area. Special emphasis is in this course laboratory part placed on

- graphical PC subsystem,
- multimedia and
- graphical workstations architecture.

1. Graphical PC Subsystem

There are several interesting subjects in this field, namely SVGA and TIGA.

By SVGA is meant a graphical PC subsystem with at least 649x480/256. We are dealing with these topics especialy in the context of the modern PC architecture features, the local bus architecture.

Due to the fact that the SVGA standard does not exist yet, SVGA is an excellent example of implementation troubles. Sometimes the only solution is VESA-BIOS. We offer particular course projects and they are solved by students quite initiatively. They often offer the solution on their private computers. In this case, common HW seems to be the Cirrus Logic IC (CL-GD5426) . A lot of price-affordable computers with ISA or Local-Bus are equipped with this particular chip. Also in our laboratory there is a Local-Bus 486DX2/66MHz motherboard, which they can use.

Quite different graphical PC subsystems are those based on the graphic processors. The particular chip is mainly used for vector data rasterization, but also some other tasks (vizualization, geometric transformation, etc.) which can be solved by it.

Leading producer in this market field is for many years Texas Instruments (TMS340X0 graphic processors family).

Having bought the Artist XJS graphic board we supposed to introduce to the students an implementation tool, which would speed up the graphical PC subsystem. More than one year experience does not fit to our expectations. This class adapters are relatively numerous in the praxis, but they are mainly used in closed applications (various CADs). Hardly anybody is programming them in an application, and so, besides the experience also motivation for students is missing. Another problem is that for an effective program design and debugging the TIGA Developer's Kit (TI standard SW, installed on our computers) is not enough. The complete developing system including the graphic processor emulator would be necessary. Last but not least there is a lot of troubles with the particular board itself (producer Artist Graphics - USA, CZ distributor Art Graph Computer).

2. Multimedia and Multimedia HW

We intercepted this relatively new trend of computer applications in the last year under the kind support of University Develpment Grant (Grant 3823/93 - "Multimedia in University Education"). Our HW background is now increased by several items, namely sound board Pro Audio Spectrum 16, which is able to store and replay the acoustic data in the CD quality (stereo, 16 bits, 44,1kHz). There is a SCSI interface on this board which is used for CD-ROM internal Toshiba XM-3401 unit. The input chain for picture digitization is in our case represented by the Screen Machine II board made by Fast. This board is used for videocamera and also videoscope picture digitization. Also common TV-composite signals can be connected. In our laboratory videocamera NV-S78E by

Panasonic (SuperVHS-C, stereosound) and videoscope NV-SD20EE by the same producer are utilized. The whole multimedia system is PC-oriented and we use it under the Windows 3.1 operating system. In the particular projects single components can be used under special DOS drivers.

Multimedia presentations development is supposed to be done in some other courses under the AuthorWare Star, GRASP, 3D Studio and Animator Pro Software.

3. Graphical Workstations Architecture

For the field of parallel implementation of computer graphics algorithms, a very promissing HW for us is the MTM-PC board from Parsytec GmbH. It includes 4 T805/25MHz transputers, each with 2MB of memory. The system interface is ISA and so the PC is used to support the user interface and as a development tool. In our case the projects are supposed to be C programmed, so the C-Toolset is installed.

Our HW offers (of course with 4 transputers only very limited, but still applicable) reconfigurable network of transputers. But for many of the graphical applications is our HW not sufficient enough. Mainly the transputer oriented output chain is missing. Such a chain can be based e.g. on the G300 CRT (Inmos). Our goal is to remove this limitation and to complete our HW by an output board with at least one additional transputer and the transputer CRT. On the base of this set some parallel implementation experiments would be better possible.

Our last big acquisition is the graphical workstation IRIS Indigo, made by Silicon Graphics. The purchase was succesfully finished in the real end of '93 thanks to the University

Development Grant again. Our experience with this HW will be described in the next Computer Graphics School.

Literature

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