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More Experiences with TANGO Interactive in Synchronous Distance Learning Courses

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Abstract:

The Northeast Parallel Architectures Center at Syracuse University and the Computer Science Department at Jackson State University are now in their fourth semester of teaching computational science courses using the TANGO Interactive collaboratory system. All the course materials are on-line, and lectures are given twice a week in real time over the Internet. After the successful experience teaching undergraduates at JSU by faculty at SU in the first year, this report covers additional aspects of the teaching experience for graduate classes in the second year, additional improvements of technology for dealing with network bandwidth issues and teaching support, and the start of JSU faculty teaching a distance course at a third university.

Keywords:

computational science, distance education, TANGO, synchronous learning, Internet

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Introduction

The computational science education group at the Northeast Parallel Architectures Center (NPAC) has developed a huge repository of online course material, including lectures, tutorials, and programming examples in various languages. Many universities are using similar collections of on-line materials to teach asynchronous on-line courses. While this is an important teaching avenue for highly motivated and independent learners, we believe that a significant majority of students require regular and sustained interaction (i.e., synchronous learning activities) involving teachers and other learners, in addition to asynchronous learning materials. In this project, we deliver synchronous courses by using the TANGO Interactive System, which was developed at NPAC, to provide colloborative services over the Internet between instructors at one site and students at other sites.

In the first year of the project, instructors at SU taught the course CSC499, Programming for the Web, for two semesters at JSU to undergraduates. This teaching was primarily successful and many lessons were learned about teaching style in this distance learning format, network performance management, and collaborative tools useful for distance learning. These are reported on in Synchronous Learning at a Distance: Experiences with TANGO, presented at Supercomputing 98 in November 1998.

In this second year of the projects, instructors at SU taught a graduate course at JSU in the fall of 1998, and are now teaching another graduate course at three sites: JSU, Mississippi State University, and Clark Atlanta University. In this report, we discuss additional lessons learned teaching graduate students in the distance format, and in using three sites.

One of the goals of the distance learning project was to provide courses in new areas of computer science that the faculty of the remote university had not yet provided. This transfer of the ability to teach courses in web technologies is also taking place in this second year of the projects.

CPS 615, Computational Science for Simulation Applications, Fall 1998

The course CPS 615 was developed at Syracuse University in the College of Engineering and Computer Science as the graduate level introductory course in computational science for scientific simulations. It is designed to teach the basic tools from mathematics and computer science that are needed to give high performance computational solutions to scientific and engineering problems. The course outline is:

- Introduction to High Performance Computing
- Parallel Computer Architectures
- Parallel Programming Models and Software
  - SPMD (Single Program Multiple Data) using the Message Passing
  - Interface (MPI) with the languages Fortran, C, and Java
  - Data Parallel Programming using Fortran90 and High Performance Fortran (HPF)
  - Scientific Visualization using Java applets
- Algorithms and Software for Mini-applications
  - Numerical integration including adapative methods
  - Floating point arithmetic
  - Full matrix algebra
  - Random numbers and Monte Carlo methods
  - Ordinary Differential Equations
  - Partial Differential Equations

In this course, the programming assignments were done in C using MPI on parallel computing resources at NPAC at SU. This was done via a web-based Virtual Programming Lab (VPL), where the students could develop and submit programs via a web page interface to the machines at NPAC.

More information on this course can be found at: http://www.npac.syr.edu/projects/jsufall98/

As in the previous distance learning courses, lectures were scheduled twice a week via TANGO Interactive. Lecture and other resource materials and assignments were posted to the class web page, and students submitted their homework on-line and could see the grading results in an on-line database. The

primary method of interaction between students and instructors was via email.

CPS616, Computational Science for Information Applications, Spring 1999.

The course CPS616 was developed at Syracuse University in the College of Engineering and Computer Science as a graduate course that surveys several software technologies of current interest for use with integrated systems in collaboration, databases, and distributed computing. Specific topics in the course evolve rapidly to include leading edge technologies. Currently included are Web interfaces to relational databases using JDBC, JavaScript and advanced HTML such as DHTML (Dynamic HTML) for rapid development of user interfaces, the use of CORBA to connect distributed applications, component programming with JavaBeans, and security and commerce software. The course assumes a familiarity with Java programming.

The course is currently being delivered to three different sites: Jackson State University, Mississippi State University and Clark Atlanta University. The lectures are delivered twice a week at the same time to these three sites using TANGO Interactive. The students primarily complete their homework using computing resources at NPAC, but also use software systems in their local labs. As in the other distance learning courses, the class web page is the focus of course materials, assignments and viewing grades. Interactions take place primarily via email.

More information on this course can be found at: http://www.npac.syr.edu/projects/jsuspring99/

CSC499, Programming for the Web, Fall 1998 and Spring 1999.

This course was taught in the first year of the project by SU faculty to JSU students. One of the reasons for selecting and teaching this course was that this material was not offered by any other JSU course. The contents of the course were carefully chosen to seamlessly match the technology with which the course is being delivered. Therefore, the Web technology (TANGO Interactive) was used to teach Web technology. The course covers the following topics: HTML and Web architecture, CGI programming with Perl, and Introduction to JAVA programming. During the spring semester, one of the JSU faculty attended the class to learn the material. During the fall semester of 1998, he taught the class at JSU. During the spring of 1999, he is successfully utilizing TANGO Interactive to deliver two parallel class sessions, one at JSU and the other one at Morgan State University. More information about this course can be found at http://homs.jsums.edu/courses/csc499

The TANGO Interactive collaboratory system

TANGO Interactive is a Java-based web collaboratory developed at NPAC. It is implemented with standard Internet technologies and protocols, and runs inside an ordinary Netscape browser window. Although TANGO was originally designed to support collaborative workgroups, in this project it was used to synchronously deliver course materials stored in an otherwise asynchronous repository.

The primary TANGO window is called the *Session Manager* (SM). From the SM participants have access to many tools including:

- *WebWisdom*, a presentation environment for over 400 foilsets;
- *SharedBrowser*, a special-purpose browser window that "pushes" Web documents onto remote client workstations;
- *WhiteBoard*, for interactive text and graphics display;
- 2D and 3D *Chat* tools;
- *BuenaVista*, for two-way streaming audio and video.

At the beginning of each class, the instructor and the students in each lab site all start up a copy of the CA on their workstation by clicking a browser link. The instructor initiates a "session" of each tool that is to be used in class and "joins" each student to the session. This starts up a window on the student's workstation where they can see each action of the instructor with that tool.

More information about each tool and its use in distance education can be found in the previously cited report at Supercomputing 98.

Changes in the use of technology

One of the most significant changes in the use of the technology from the first year to the second was in the improvement in the overall Internet performance. This enabled two-way video to be routinely deployed between the instructor and each lab site.

In the first year the Internet connection between Syracuse University and Jackson State University was very unstable, many times interrupted and changed by Internet Serice Providers. In the second year the situation was signifficantly improved. In Fall 1998 we have very stable, symmetric connection between NPAC and JSU. The minimal packet loss and (most of the time) a very good available bandwidth (on the level ~1.5 Mbps in both directions, limited by T1 link between JSU and CEWES) allowed for uninterrupted audio and video delivery. In Spring 1999 additional sites joined (CAU and MSU). We no longer monitor the quality of network because it seems to be stable. Random checks give the following average numbers:

- JSU: 1.2 Mbps in both directions, 5% packet loss (packet size 5000 bytes)
- CAU: 1.3 Mbps in both directions, 7% packet loss (packet size 5000 bytes)
- MSU: 3.3 Mbps in both directions, 3% packet loss (packet size 5000 bytes)

Another significant improvement was in the installation of a proxy web server at the remote site. This changed the architecture from one in which remote copies of lecture slides were served to the remote students to one in which one copy from the lecture site was sent to the remote site and duplicated for the students. This had a significant effect on the preparation time required of instructors since they no longer had to duplicate course materials at the remote site for rapid deployment during the lecture. This proxy server architecture is effective when the remote site has several computers trying to access the same page from the web server providing the course material.

Starting in the spring semester, a TANGO server dedicated to courses was installed in NPAC and all students from different locations join this server.

The additional remote sites represent a variety of lab setups for the use of TANGO Interactive for instruction. The JSU lab consists of a number of high-end multimedia PC's. One central SGI O2 (Irix 6.3) is used to receive audio and video and project the video on a large screen. But the students use the

individual workstations for viewing the lecture slides and using the chat. At Mississippi State University, however, all the TANGO sessions are received on a central SGI O2. The audio and video are received here, and all of the video, lecture slides and chat are projected on a big screen to all the students. TANGO Interactive plugin is also installed on a few additional lab SGI Unix workstations (Irix 6.2) so that some students can view their own slides and use the chat sessions during class. At CAU, again there is one PC (Windows 98) to receive audio and video. The same PC is used by 2 students to join Chat sessions and follow slides on Shared Browser.

During the second year the TANGO Interactive software was upgraded twice: first in the middle of 1998, than in March 1999. The current distribution of TANGO Interactive 1.4 provides significantly improved quality of audio and video, and also lowers the required operational characteristics of the network connection.

Lessons Learned

Many of the lessons from the first year as far as lecturing style and the importance of the remote instructor were also valid in the second year.

One of the differences was in giving lectures to graduate students instead of undergraduates. The remote instructor found that it was more difficult to hold the attention of the graduate students and to get them to take the lectures seriously. In response to this issue, this spring semester, we are giving an occasional quiz that will count as part of a "participation grade" to encourage students to attend class and pay attention in lectures.

On the other hand, the graduate students seemed to have less difficulty "bonding" with the instructor and feeling comfortable with asking questions. This may be due to the improvement of visual contact by having the video available, but may also be due to the maturity and indepence of the graduate-level students.

In particular, in the final course evaluations (see the Appendix below) the graduate students in the fall gave a significantly higher rating to the overall use of TANGO interactive as a method of course delivery. (The rating was 6.6 on a scale of 1 to 7, while in the fall and spring of the previous year, the undergraduates gave ratings of 3.5 and 5.3, respectively.) This can be due to many factors including the improvement in TANGO Interactive software, network performance and the different level of the students.

Another difference is in having three sites instead of one. This does not seen to have any additional effect on the lecturing style and in the use of the collaborative tools during class. There is additional overhead for the technical staff to oversee the additional TANGO setups and to monitor network problems.

Over the course of the project, there has been a significant difference in the amount of personal travel of instructors and support personnel to remote sites. For the first class at JSU in the fall of 1997, two TANGO personnel spent two days at the site installing the TANGO server and training the local lab manager. The instructors spent three days at JSU to teach the first two classes in person to get the students started using the TANGO system, and one instructor visited two additional times during the rest of the semester. In the spring of 1998, there were also three visits by instructors. In the fall of 1998, the additional network bandwidth made video possible and the instructors made only two visits.

In the spring of 1999, three additional remote sites were added and no personnel or instructor visits were made. The fact that this was possible significantly reduces the cost of distance education. One TANGO server was installed remotely for the use of the JSU instructor to teach at Morgan State. Two additional TANGO enabled labs were added to the SU course at MSU and CAU. These TANGO installations required lab personnel to install the software and to spend several hours testing with TANGO personnel in Syracuse. The main lab manager learned how to use TANGO from the web instructions and was able to get the students started.

From the instructional side, the students did not have the instructor available in person to start the course. Primarily, they made use of chat sessions instead. We found that for the first 4-6 sessions of the class, about half an hour was spent after class answering students' questions about the syllabus and operation of the course and in getting students started using the remote computational facilities. In the future, we will include this as part of the startup of the course.

Conclusions

In this second year of the project, we are again successfully teaching distance-learning courses using the TANGO Interactive collaborative software. The software is now in a mature enough state to more easily allow installation at remote sites, a wider variety of machines are successfully being used, and network performance has increased to allow better contact between instructors and students via video.

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Appendix: Course Evaluation

Below are the results of the CPS615 Computational Science for Simulation Applications, Fall 1998 course evaluation. The questionnaire was filled out by 5 students in December 1998.

Course Contents	**Mean**	**Std Dev**
Volume of Material	5.8	0.75
Presentation Clarity	5.6	0.49
Personal Interest:	6.0	0.63
Textbooks:	5.4	1.20

Lectures:	5.8	0.98
Programming Examples:	6.6	0.49
Programming Assignments:	6.4	0.49
Web Materials:	6.2	0.75
Final Project:	5.4	0.80

(1 = Poor, 4 = Adequate, 7 = Excellent)

Out of the 5 students, 3 felt that the Examples were the most helpful course component, and 3 felt that the Web Materials were the least helpful.

TANGO Tools	**Mean**	**Std Dev**
Chat	6.6	0.80
WebWisdom	5.6	0.80
SharedBrowser	5.5	1.1
WhiteBoard	5.4	1.20
Audio	4.4	1.00
Video	3.8	2.50
Importance of Video	5.2	1.70
Overall Evaluation of using TANGO software for course delivery	**6.6**	**0.49**

(1 = Poor, 4 = Adequate, 7 = Excellent)

Syracuse instructors made three visits to JSU during the spring semester. Were these visits helpful? Why or why not?

Yes they were very helpful. the personal interaction with nancy and geffory, was indeed helpful. saleh was of great assistance as well. thank you, i really enjoyed the class.

Yes, but not much. They came too suddenly without prior notice, otherwise, we might prepare some questions. But, anyway, we were glad to see you.

The visits are useful as we have personal interaction with them.

Yes, it helped us to know our instructors

Yes, because we had face to face talk.

How could the method of course delivery be improved?

Conduct some exams based on lectures delivered in class instead of grading purely on assignment. Because assignement are based on purely MPI module which we can do follwing examples given without any reference to class lectures.

Make sure the microphones are in working condition to enable students to ask questions immediately.

Give more handouts and assign more books.