

## International Collaboration

Our project was a collaboration between researchers and students in three different countries on two continents. Our team was located at the Florida A&M University / Florida State University College of Engineering in Tallahassee, FL, USA. Our sponsors were at CERN, the particle physics research lab, near Geneva, Switzerland. A team from Bucharest, Romania, was also assigned to the project.

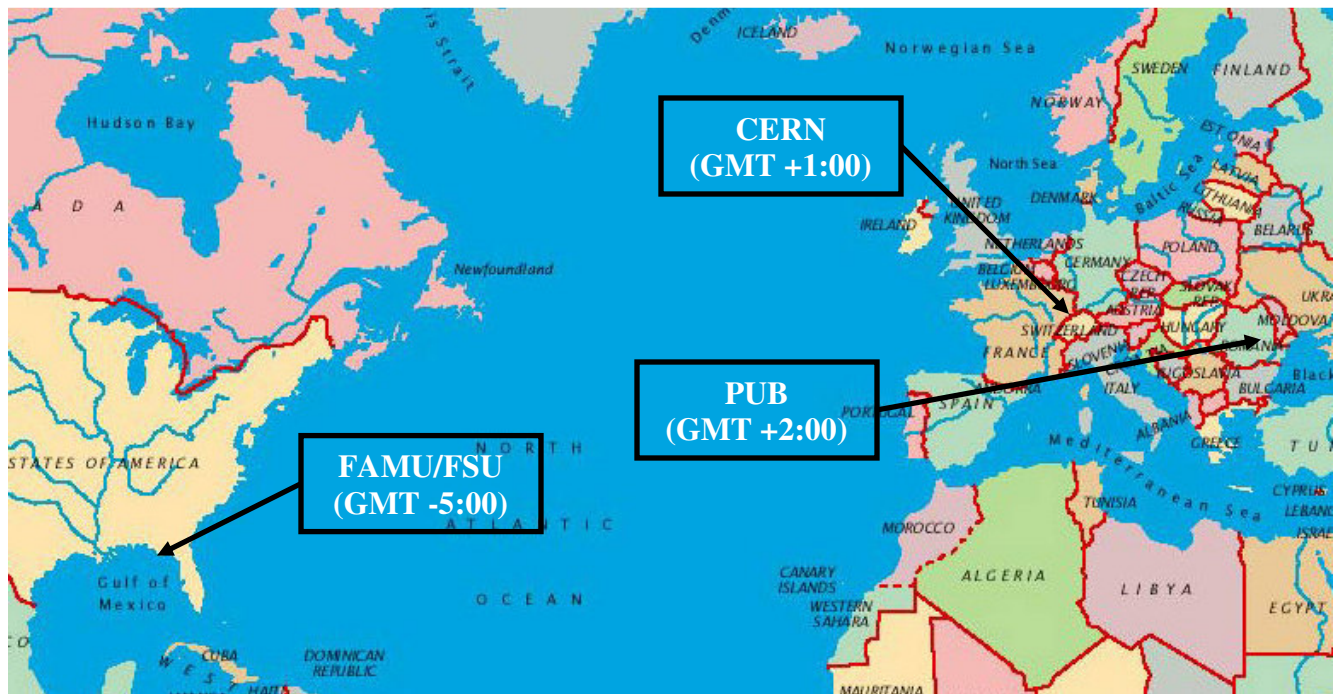


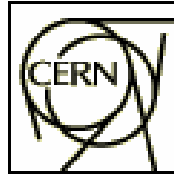
Fig. ##: The project involved people in the United States, Switzerland, and Romania (www.atlapedia.com)

### **CERN**

Located in Switzerland near Geneva, the CERN particle physics research center's time zone is GMT + 1:00 (GMT + 2:00 during the summer), making it 6 hours ahead of Tallahassee, Florida (7 hours ahead during the summer). Our work has been in support of the LHC project at CERN, and our sponsors, Dr. Luca Bottura and Dr. Nathan Brooks, were both located in Switzerland for the duration of our work.

In early September 2005, a contact list, including the names, telephone numbers, and mailing address of the FAMU/FSU team, was created and sent to sponsors at CERN so that they could fill in their contact information and send it back to us.

Communication with our sponsors at CERN was accomplished exclusively through email. Dr. Brooks was our primary point of contact. He sent project scope and objective details by email attachments.



Periodically, we updated him on our progress, addressed questions to him in order to clarify important issues, and forwarded to him our written documents.

Our experience was that emails and file attachments were adequate to get the information that we needed in a timely manner. However, it would have been helpful to have established a more regular update to the sponsors at CERN. A weekly email update would have kept the teams in sharper focus and given a greater sense of urgency.

### **Politehnica University of Bucharest**

The Politehnica University of Bucharest (PUB) is located in the capital city of Romania. The time zone in Bucharest is GMT + 7:00 (GMT + 8:00 during the summer). Regular, detailed communication was a necessity between the teams at FAMU/FSU and PUB to ensure project cohesion. To this end, several different forms of communication were used.

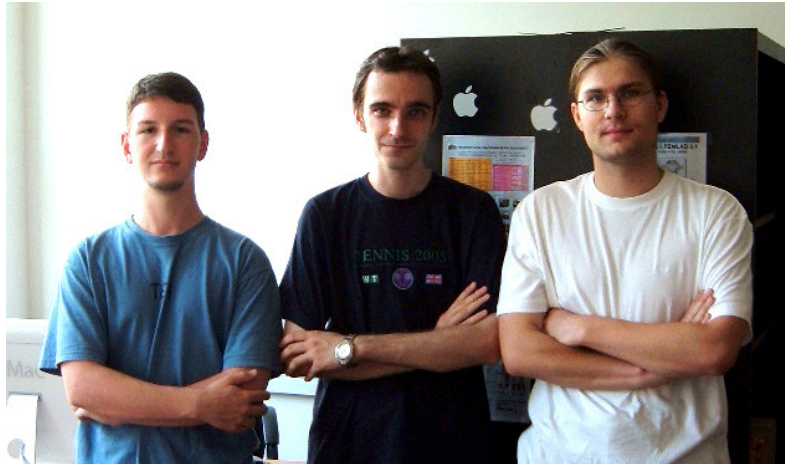


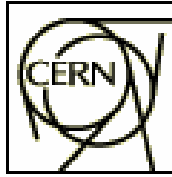
Fig. ##: The PUB students: Ion Morega, Marius Panait, Cosmin Mogos.

#### *Email*

Introduction to the PUB team was made through email. The same contact list sent to CERN was also sent to the PUB team so that they could fill in their contact information. Throughout the year, much of the important and productive correspondence occurred by email.

#### *Video Conferencing*

Within a couple of weeks after the beginning of the fall 2005 semester, plans were also laid for an initial video conference with the PUB team. The PUB team informed us that, although they did not have access to a video conference room, they had webcam capabilities. They suggested that Microsoft NetMeeting, a webcam conference and application-sharing program available freely with Windows XP, would allow us to interface our video conferencing equipment with theirs.



After a few attempts to schedule time in the video conference room at our college of engineering at a time that would also work for the PUB team, our first video conference took place on October 12. The PUB team connected over the internet to the video conferencing equipment. We found that the internet did not work well for both audio and video over such a long distance: the video was choppy and eventually the feed died out. The audio started clear, but eventually died as well. It was clear that some other solution would be needed.

### *Tele-conferencing*

It was decided to change the video conference to a teleconference. For this, we obtained international calling privileges for the mechanical engineering conference room telephone. We set up a bi-weekly teleconference with PUB at 9:00 AM local time (4:00 PM Bucharest) on Wednesdays. Our first successful teleconference occurred on October 19, a combination of Microsoft NetMeeting with webcams and an international telephone call. We largely held to the biweekly schedule for the remainder of the project.

We found the video and teleconferences to be awkward at first. It was difficult to organize thoughts and get detailed, precise information across. The webcams worked only irregularly and did not help with understanding or completing the project. Overall, the video and teleconferences did not turn out to be as productive or useful as we expected. They were valuable, however, in that we could see the faces and hear the voices of those with whom we were working. Also, the conferences were typically followed by our regular team meeting and often stimulated discussion among members of our local team.

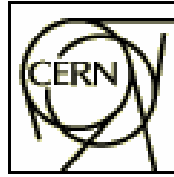
### *Blackboard File Exchange*

A web-based software tool called Blackboard is available to professors at the FAMU/FSU College of Engineering. One of the functions available is the creation of "group pages" which allow members of a group to share files and exchange messages. We made use of this capability extensively among ourselves to upload and share files, documents, and presentation slides.

We found it useful to get guest accounts for the PUB team so that they could make use of the file exchange capabilities. In this way, they could access all of our deliverable documents and background research papers without us having to attach each one to an email. Although they also presumably had the capability to post their own files to Blackboard, the members of the PUB team elected to not make use of this function, preferring instead to email and attach files.

### *Yahoo Messenger*

Another valuable form of communication was Yahoo Messenger, an internet chat program by Yahoo, Inc. In addition to one-to-one text chatting, Yahoo Messenger also has file exchange, webcam, voice, and conference capabilities. Mostly, we made use of the one-on-one chat and file exchange. Yahoo Messenger became invaluable for quick questions, instantaneous clarifications, and detailed



development of ideas. Most of the PUB team members were available on Yahoo Messenger until late in their evening hours, so we were able to address project issues throughout the day.

For example, when one of the PUB team members had a concept for the motor controller circuit, he was able to immediately draw it on paper, scan it, and send it over Yahoo Messenger so that there was no delay in getting the idea across.

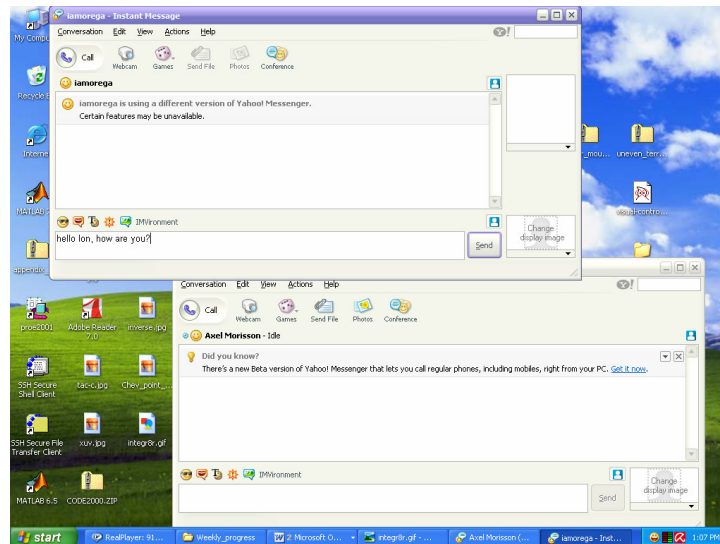


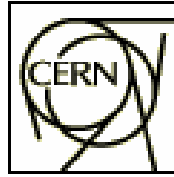
Fig. ##: Yahoo Messenger allows multiple one-to-one chatting windows, facilitating simultaneous communication with several individuals in remote locations at once.

### *Dr. Morega's Visit*

During the months of February and March, Dr. Alexandru Morega, the professor of the PUB Team, was in Tallahassee working with researchers at the Center for Advanced Power Systems. Luckily for us, he made himself available to meet with us during a critical phase in our project. Over the course of several meetings between him and our team, he was able to see our system and give some important advice about:

- the motor power source,
- the motor and controller circuit,
- the feasibility of our speed control scheme,
- how to characterize the behavior of the system, and
- the appropriateness of the integrator circuit

We found his advice to be crucial to the advancement of the project.



*Federal Express*

As the PUB team began developing the software, it became obvious that it would be advantageous for them to be able to use the same data acquisition hardware that we would be using locally. To facilitate this, we mailed an identical data acquisition card and module, via Federal Express, to the team in Bucharest. This allowed them to design the software with a greater degree of certainty that it would work with the physical system.

**Work Breakdown**

Early in the fall semester, an effective and sensible division of labor was top priority. Since the PUB team would never come into physical contact with our team at FAMU/FSU (except for Dr. Morega’s visit, which was unknown to us until January 2006), we had to divide the tasks in a way that maximized the abilities of the team members while allowing the project to be completed efficiently.

The test was to be physically conducted here at FAMU/FSU, so the mechanical and electrical construction had to be done here. We needed a sophisticated software program to interface with the data acquisition equipment and other hardware, control the system, conduct the test, and gather data. Since software is easy to transmit electronically and the PUB team has a strong background in electrical and computer engineering, they elected to develop the LabVIEW program and analyze the experimental data. It turned out that they also worked on the motor controller and integrator circuit designs, and were also involved in all areas of the project.

The full work breakdown structure (WBS) is shown in figure ##.

CERN Team Work Breakdown Structure

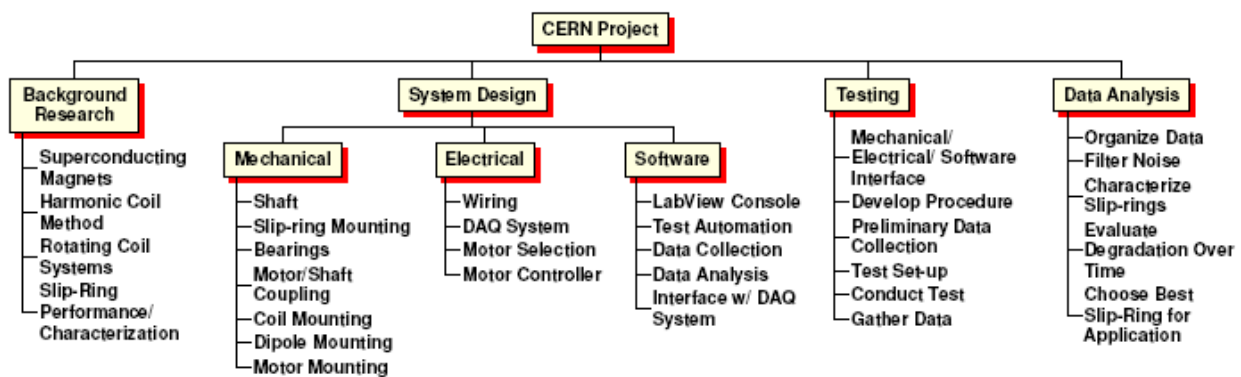
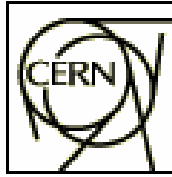


Figure ##: The PUB team’s official tasks fell under software, testing, and data analysis, but the team members were very involved in all aspects of the project.

We found the manner in which we broke down the work to be effective. The team members at PUB were able to bring to bear their expertise in LabVIEW, Java programming, and circuit design. The



members of the FAMU/FSU team were able to use their knowledge in mechanical design, fabrication, and assembly, and in electrical design.

### ***Conclusions and Overall Impression of International Cooperation***

Our experience with the team in Romania was very positive. The multiple forms of communication available to us allowed us to share information effectively enough despite the large physical distance between the teams. Often, progress would have been more rapid if the PUB team members were actually able to visit us and see the system, but with a little bit of creativity we managed to make the work of two disparate teams coalesce.

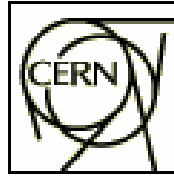
On a more personal side, it was rewarding and educational to get to know four people from a different part of the world. The enthusiasm of the PUB team helped us to stay motivated and focused. Despite the fact that they received no academic credit for their work on this project, they put in significant work and made themselves available for communication with us at all hours of the day and night. It was clear that they had a deep commitment to the project's success. Without their expertise, advice, and hard work, it would have been impossible for us to achieve a working test bed in the limited time that we had.

For us, the sponsors at CERN felt more distant. Dr. Brooks always answered our questions and concerns in a timely manner by email, but other forms of communication would have been helpful. For instance, we should have sent him more pictures of the system components throughout the semester so that he could provide advice and corrections on each element.

If Dr. Brooks had been able to actually visit us once or twice throughout the year, we might have avoided some of the mistakes and conceptual misunderstandings that cost us quite a bit of time. However, we realize that such visits were impossible. Our team should have made more of an effort to involve Dr. Brooks in the project in other ways. Future senior design teams will have to be creative in this area.

By itself, the project was interesting and challenging. The additional complications of dealing with a three-way international collaboration made it even more demanding. For future teams that will deal with such a project, we recommend that the following be emphasized:

- **A quick opening of the communication channels.** At the very beginning of the fall semester, the first priority should be to get dialogues going in multiple forms of communication. The methods described in this document worked for us, but could be expanded upon. Things take longer when dealing with such large distances and time differences, especially if one or more parties are not available in the evenings, so it is especially important to start communicating early.
- **Regular communication.** It is critical to the success of any project to have regular meetings and updates with sponsors and co-workers. Costly misunderstandings, misdirected tangents, and time wasting can be avoided.



- **Use different media to communicate.** Pictures, video, drawings, and schematics are absolutely necessary to supplement the text of an email. It takes more time to draw a good picture than to write a paragraph, but a graphical representation of an idea is invaluable, especially when the recipient is not able to be physically present to see the system components. Future teams will have to be creative in finding ways to get information to sponsors and co-workers.