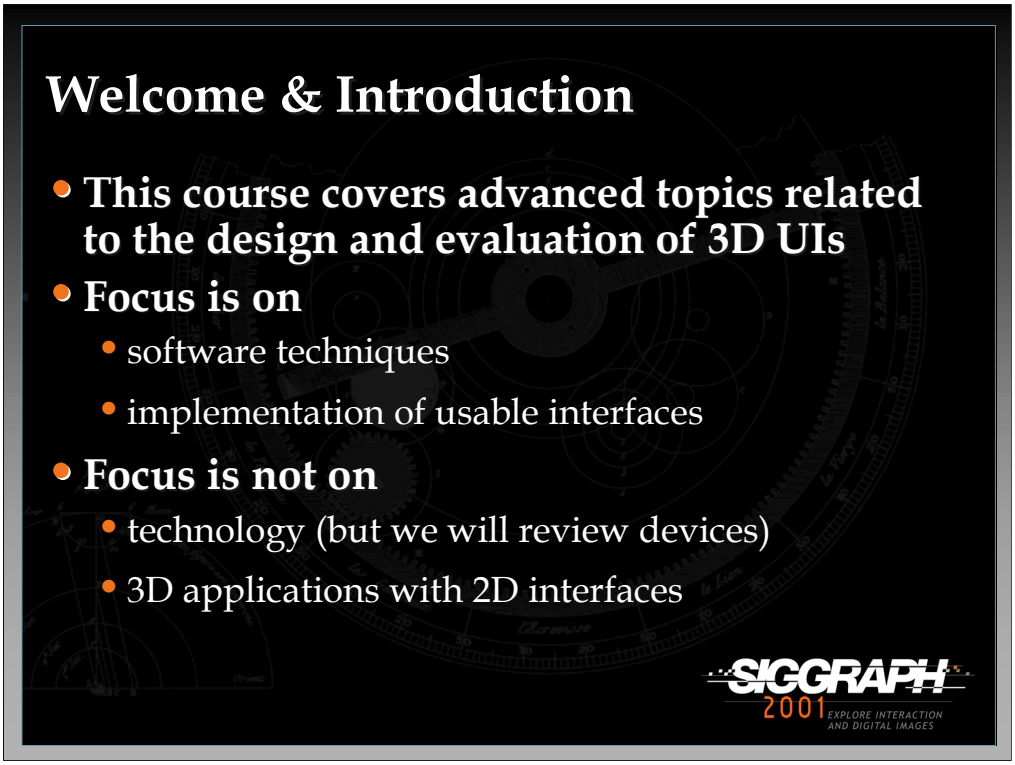
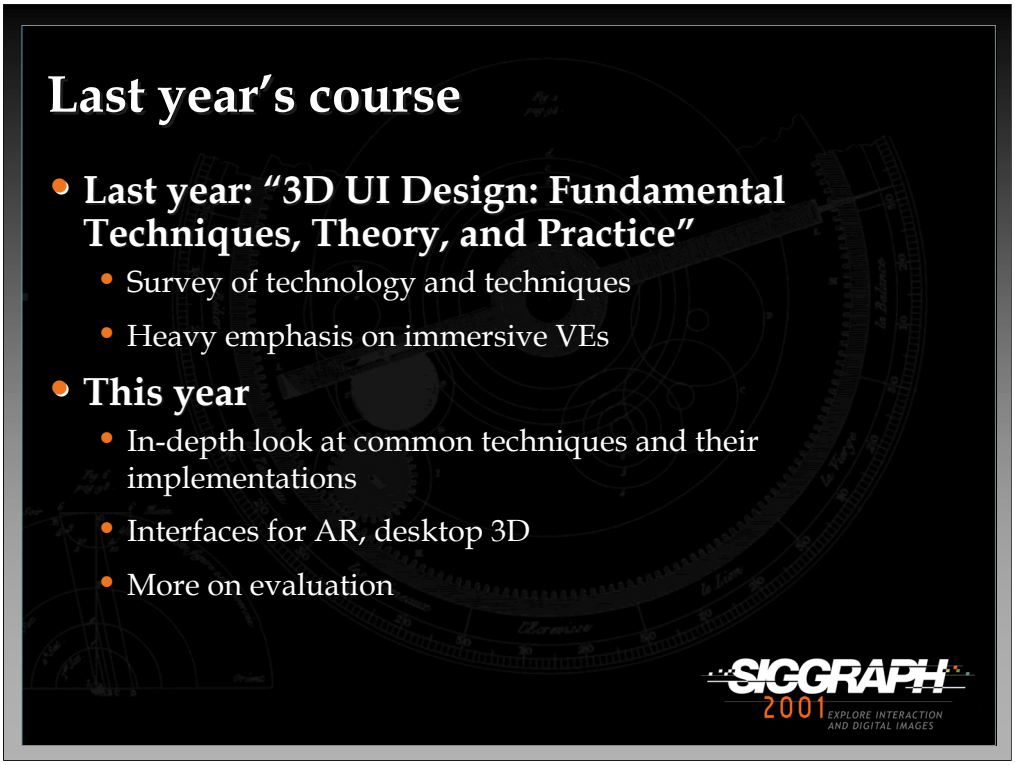
Welcome to SIGGRAPH 2001, and to the course on “Advanced Topics in 3D User Interface Design”.

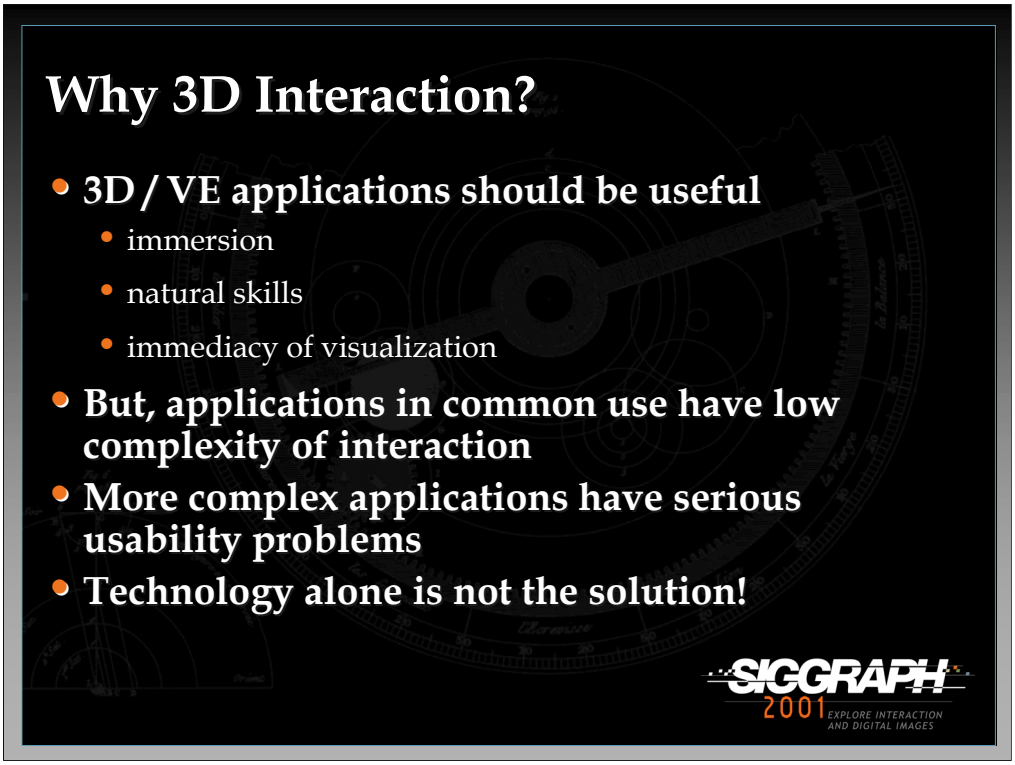


Three-dimensional (3D) interaction is an exciting field of research that promises to allow users to perform tasks freely in three dimensions rather than being limited by the 2D desktop metaphor of conventional graphical interfaces. Applications of immersive and desktop virtual environments (VEs), augmented reality (AR), and ubiquitous computing all require efficient and usable 3D interfaces. However, spatial interaction is not well-understood and presents significant new challenges that are not addressed satisfactorily by traditional 2D human-computer interaction (HCI) research. Some 2D techniques have proved useful when implemented in 3D, but these are not sufficient. Therefore, we offer this course highlighting the current state of the art.

The course is advanced, so it assumes that the attendees have some background in developing 3D systems, in basic human-computer interaction and user interfaces, and a basic knowledge of common 3D interaction techniques. We will focus here on interaction techniques, not on technology/hardware (however, there will be a review of some important and novel 3D input/output devices, with a view towards their use in interfaces). We are talking about truly 3D interfaces, not 2D interfaces to 3D applications (e.g. 3D modeling packages on the desktop).



This course builds on a course offered at SIGGRAPH 2000 titled 3D User Interface Design: Fundamental Techniques, Theory, and Practice. That course focused on the basic input and output devices and interaction techniques for 3D applications. Here, we will present a more detailed discussion of implementation issues and strategies, including the mathematical basis for various techniques and software tools that can be used for implementation. We will also discuss several strategies for 3D interface design, and methods for integrating diverse interaction techniques into applications. We will also present methods for usability evaluation of 3D interfaces, and finally will include a special section on 3D interaction in specialized interface styles such as augmented reality and desktop 3D interaction.

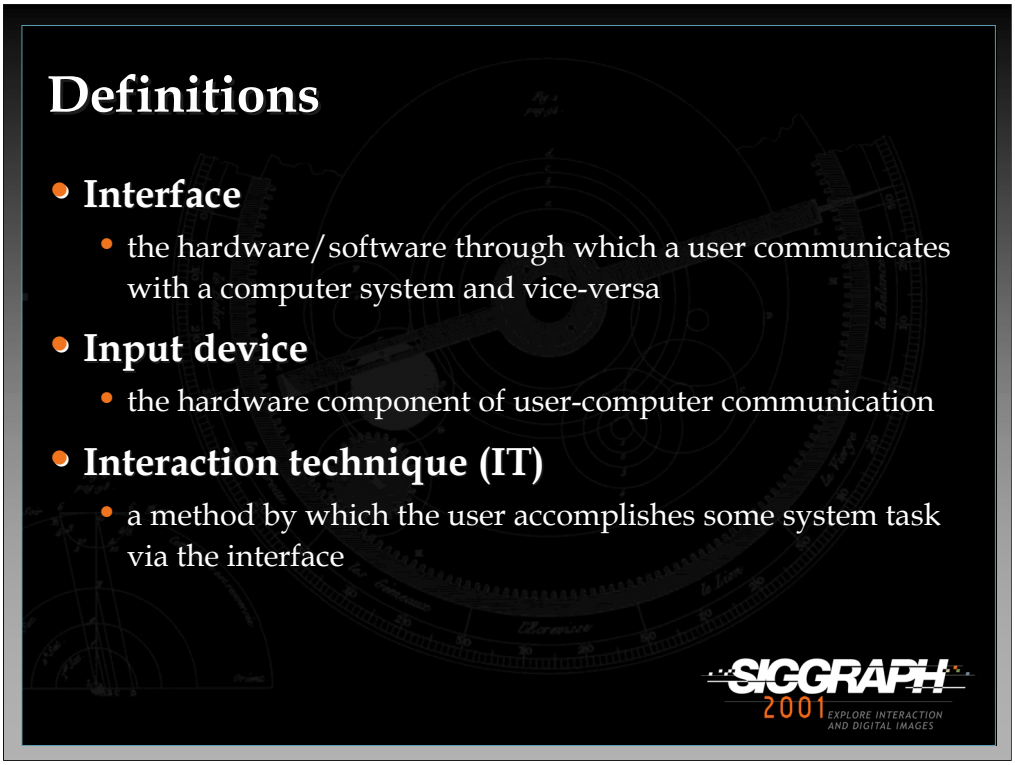


Three dimensions and virtual environments intuitively make sense for a wide range of applications, because of the characteristics of the tasks and their match with the characteristics of these environments. Immersion is the feeling of "being there" (replacing the physical environment with the virtual one), which makes sense for applications such as training and simulation. If a user is immersed *and* can interact using natural skills, then the application can take advantage of the fact that the user already has a great deal of knowledge about the world. The immediacy characteristic refers to the fact that there is a short "distance" between a user's action and the system's feedback that shows the result of that action. This can allow users to build up complex mental models of how a simulation works, for example.

Most applications in common use (e.g. walkthroughs, psychiatric treatment, entertainment, and training) contain user interaction which is not very complex. Other types of applications (e.g. immersive design, education, complex scientific visualizations) are for the most part still stuck in the research lab, often because they have usability problems that limit their usefulness.

Better technology is not the only answer - 30 years of VE technology research have not ensured that today's VEs are usable - we must also focus on the design of interaction for VEs.

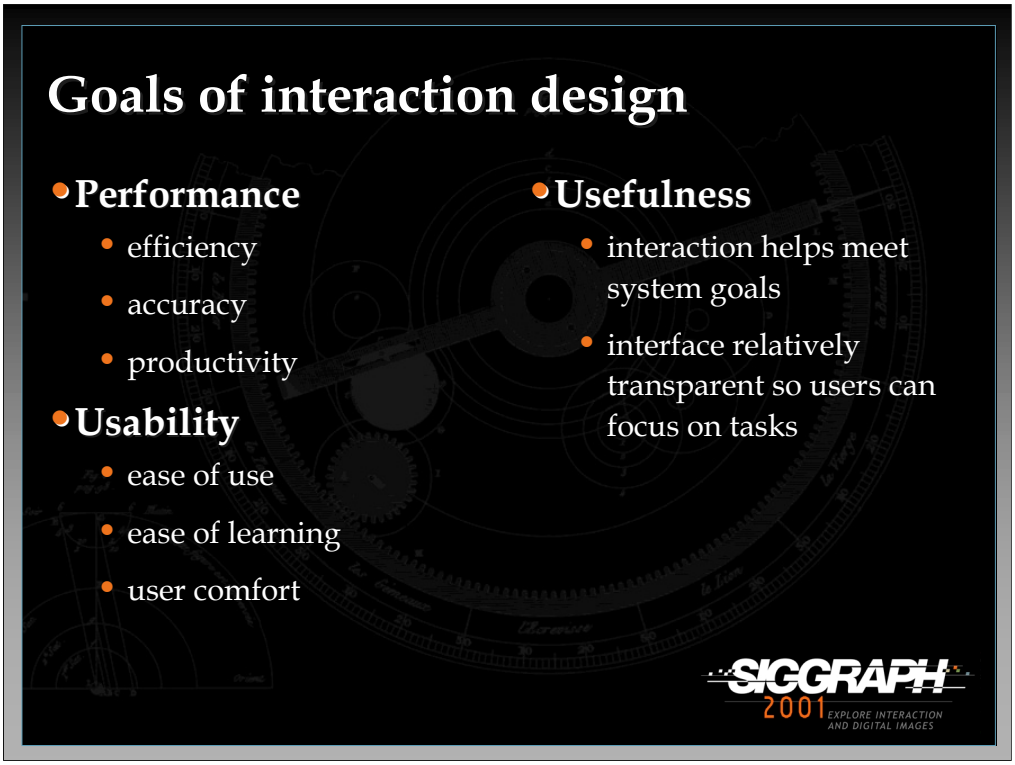
Therefore, we feel that 3D interaction is a vital topic for all 3D/VE developers, designers, and evaluators to understand.



The user interface is simply a communications medium. The user communicates to the system via input of various types. The system presents information to the user via displays/output. 3D interfaces have the potential to greatly increase the bandwidth of the communications from the user to the system and from the system to the user.

An input device is simply some piece of hardware that is used to communicate with the system (e.g. mouse, keyboard, cyberglove, stylus, touch screen, etc.). We will discuss 3D input devices in the first lecture.

An interaction technique is part of the user interface (UI). It is a method that allows the user to perform some task in the system, and it includes both hardware (input device) and software components.



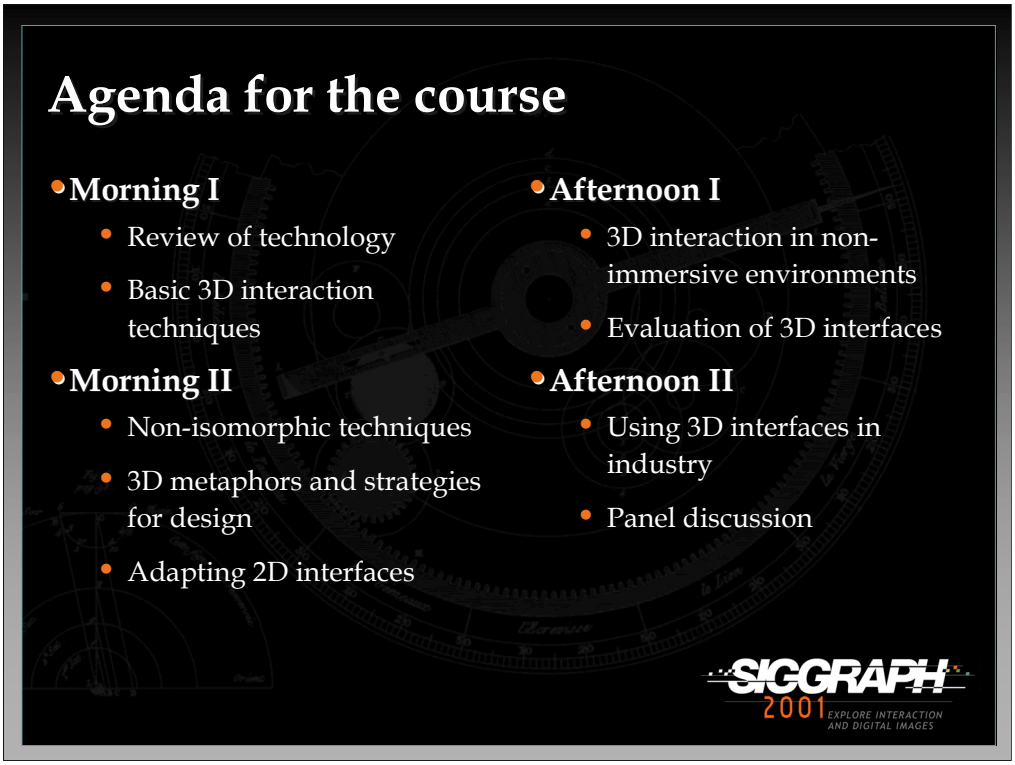
We will try to keep in mind as we discuss ways to accomplish 3D interaction tasks that we want to design for performance, usability, and usefulness.

Performance relates to quantitative measures indicating how well the task is being done by the user and the system in cooperation. This includes standard metrics like efficiency and accuracy.

Usability refers to the ease of communicating the user's intentions to the system, and the qualitative experience of the user.

Usefulness implies that the system is actually helping the user perform work or meet his/her goals, without being hindered by the interface.

All three of these goals must be considered together, as all are essential. A system will not be used if users become frustrated after five minutes of usage (usability) even if it's been shown to aid the user in getting work done in a new way. A business will not adopt a system that is incredibly easy to use but decreases productivity (performance).



See the detailed schedule at the front of these course notes.

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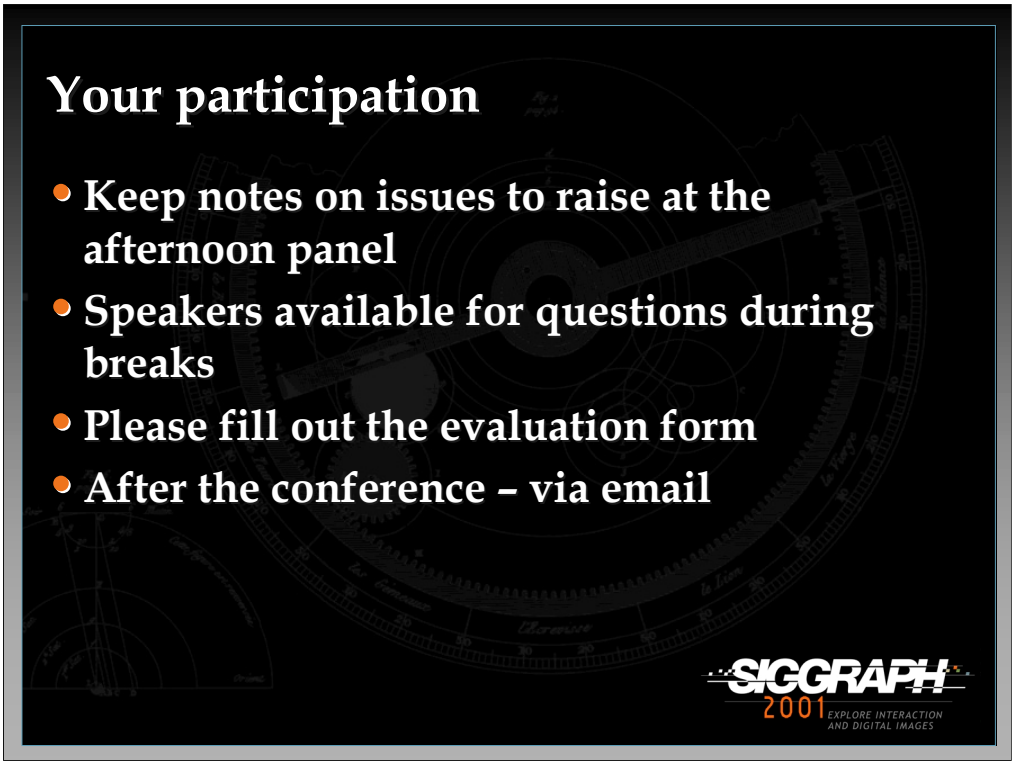

It is difficult in a course of this size to have interactions between the speakers and the audience, and most of the content here will be presented in lecture format. However, we do value your participation.

The main way you can participate is during the panel session at the end of the day. We encourage you to note questions you would like to raise during the panel as the course progresses.

As often as possible, we will leave time at the end of talks for questions, and speakers will be available during the breaks for more extensive discussions.

We also want your feedback – please fill out the evaluation form.

After the conference, feel free to email us:

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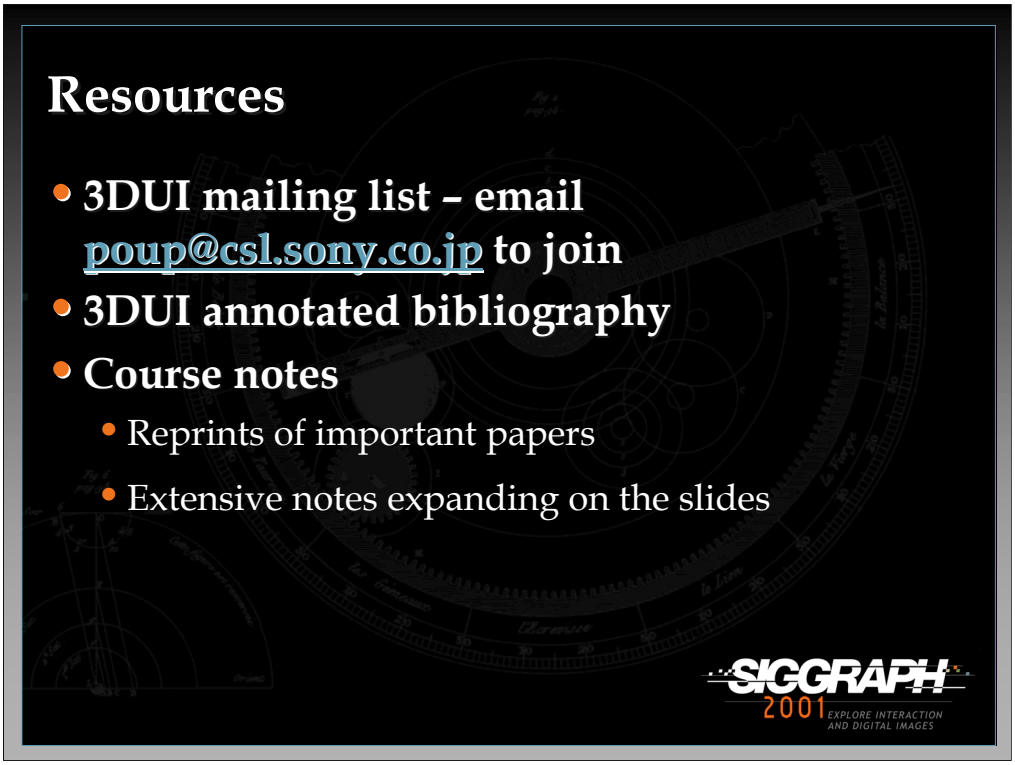

We invite those interested in pursuing this topic further to join the 3DUI mailing list, a list devoted to the discussion of 3D user interfaces and interaction. The list currently has over 100 members from around the world. Email Ivan Poupyrev to join. Also see the 3DUI home page at:

http://www.mic.atr.co.jp/~poup/3dui.html

We have included in these course notes the updated 3DUI annotated bibliography, an invaluable resource for researchers in this field. It is also available online. The course notes also include reprints of relevant articles, and the notes you are currently reading, which give additional information about almost all of the topics that will be covered in the course.