CHAPTER 5

COMPUTER-AIDED LEARNING AND USE OF THE INTERNET

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1 Introduction

The working group in Computer Aided Learning and Use of the Internet aims:

- to bring together information about resources and tools for computer aided learning (CAL) in the field,
- to promote the use of the internet to disseminate information and teaching materials,
- to make suggestions of areas of resource development to potential authors,
- to encourage the generation of a comprehensive set of high quality resources, and
- to create an infrastructure for the management of resources.

The working group consists of educational professionals who have direct experience of applying educational technology within Speech Communication Sciences. Through our research into the current use of computer-based methods, and the identification of successful applications, we hope to encourage others to experiment with their use.

In the following sections we look at the match between Internet technology and educational requirements in general, highlight the requirements of Speech Sciences in particular, give a taxonomy of available resources (with examples), criticise the current position, and discuss what are the most urgent requirements for computer-based teaching materials in Speech Communication Sciences. This review is based on a database of 80 web-based resources (see Appendix I).

2 Technology

In this section we look at the tools available for CAL on the Internet and World-Wide Web (we use 'the Web' to indicate the World-Wide Web and Internet together). We look at telematic learning in general (learning at a distance using technology) and CAL tools for Web learning environments.

2.1 Telematic Computer Aided Learning

Interest in telematic education stems from what it can offer, namely, deep learning. As adults learn well in social settings (Collis, 1995) which promote sharing knowledge and resolving the resulting cognitive conflict (Kaye, 1992), technologies which support such interactions are likely to improve adult learning. Adults often have valuable personal experiences

which they can bring to their learning, they need collaborative skills at work, and they will need to develop independent learning skills with peers when their formal education is over. These are some of the reasons why telematic education has a significant part to play in education.

There are two types of learning situation that we might wish to emulate in telematic tutoring: static lectures and interactive tutorial/seminar sessions. In order to be able to teach telematically, we need tools which facilitate computer-supported co-operative learning (CSCL). CSCL classes may be compared with contact classes along the following dimensions (Palmer & Fields, 1994):

- ***synchronicity*:** students participate in the same session at the same time (synchronous), or in sessions at different times (asynchronous).
- ***geographical distribution*:** learners may or may not be at a single site.
- ***homogeneity*:** learners may or may not all be similar in kind.
- ***coupling*:** the students may or may have to work fairly independently (loosely coupled) or in a team (tightly coupled).

Tools which support synchronous activities are generally used to realise a learning environment similar to a traditional classroom. However, this technique is not suited to situations where very large numbers of participants conduct multi-way discussions across different time zones. This is a common situation on distributed web-based courses. Hence asynchronous techniques have been developed. A typical asynchronous technique uses a form of notice-board with the difference that, instead of pinning up notices, participants attach computer files which may contain text, graphics, video etc. Over a period of weeks, it is possible for participants to respond to others' files and form chains of discussions.

The key differences between more traditional knowledge-delivery education and a 'student apprenticeship' style, more suited to telematic tutoring, are outlined in table 5.1. Ideally, telematic tutoring is active and discovery-based, and casts the tutor in the role of a facilitator of learning. Also the learning materials used on the Web are globally accessible. Hence it is important to keep materials up-to-date, in order to encourage maximum use of the materials at a given site. This is why authoring tools are important.

Table 5.1: Old and new forms of learning

Knowledge Delivery Education	Student Apprenticeship
Lectures	Discovery
Passive, solitary	Active, team-based
Omniscient tutor as controlling gatekeeper	Facilitative tutor as equal resource

Homogeneous	Diverse
Stable content	Changing content (tools used)

2.2 Internet Technology

The Internet is an information carrier - a medium - which links information providers to information users. We are concerned with the pedagogic potential of this medium: its strengths and weaknesses in respect to educational provision and educational requirements. Here the Internet is taken to mean both the physical hardware which interconnects millions of computers, and the software tools which can be used to enable teaching and learning to take place world-wide. Few of the tools were originally designed for pedagogic purposes (many arose from efforts to enable Computer-Supported Co-operative Work and Computer-mediated Communication) but many have been successfully used to enable teaching and learning over the internet.

There are many tools available for general authoring of telematic tutoring materials. The key general tools that can be used to prepare materials are shown in table 5.2, under the headings of Authoring (generating teaching materials), Components (the telematic tools themselves) and Tracking (tools to handle registration, payment and assessment).

Table 5.2: Tools for authoring Internet teaching materials

Tool	**Details**
Authoring Tools	
Authorware & Director with Photoshop/Freehand and Shockwave plugins	• Authorware: CAL production • Director: movies • Photoshop/Freehand: graphics • Shockwave plugin: WWW browsing
HotMetal or MS FrontPage	• HTML writing tool
MS-Office 97	• Paper and WWW authoring tools
AC3D	• 3D VRML authoring tool for Suns
ActiveX Control Pad + JavaScript/VBScript	• HTML writing tool with support for JavaScript and VBScript authoring • Also: ActiveX applications
Telematic Components	
Computer conferences/Newsgroups: (NNTP, Notes, 1st Class)	• Enables discussion forums to be set up and administered asynchronously
Videoconferences (JPEG, ITU H.320)	• Synchronous videoconferences
Chat: IRC, MS comic chat	• Synchronous one-to-one or many-to-many discussion
Shared applications and whiteboards	• Cooperative working on whiteboard or other application package

Email (MIME)	• Asynchronous file transmission
Video on demand (Sun ShowMe)	• Asynchronous videoconferencing and materials distribution
Search engines	• Locates material on WWW site
WWW browser: Netscape/Explorer (HTML, Java, Java/VBScript, ActiveX)	• Views material
Tracking Tools	
WEST/TopClass	• Unix/WinNT-based student tracking tools
WebCT	• Unix-based student tracking tools
CAFE-MONDIAL	• WinNT-based student tracking tools

Authoring CAL for the Web or for standalone use takes much effort. A package whose use in class might last from 30 minutes to 3 hours might take between 4-6 person-months of effort, particularly for high-quality multimedia materials with a good look and feel. There is a need for professional graphic design input, video production, CAL and pedagogical input. This makes commercial-quality CAL production a professional activity. Nevertheless, there are a number of tools available that enable the production of useable courseware in a shorter time. There are two main types: Web-only tools and Web/local tools.

There are many Web-only tools available, of which MS FrontPage and HotMetal currently receive the most accolades. MS Office 97 enables all the MS Office tools to save in Web format for direct publication. This is a good initial solution for rapid prototyping of materials (ie. documents, presentations, databases and spreadsheets) so that they can be quickly available on the Web. However, tools allowing greater graphical and animation sophistication are also required. Those not using a Microsoft server will need to know some HTML and scripting to achieve the same results. This is where the MS ActiveX control pad can offer some rudimentary support.

Of those tools which are useable both in standalone mode on a local machine and also on the Web, Macromedia's authoring suite is a favourite. It enables good-quality CAL to be produced and, with the appropriate Shockwave browser plugin, allows it to be incorporated into a Web page. This solution enables flexible software to be produced using a productive, high-level development tool that does not require knowledge of programming.

A variety of tools are detailed below with an indication of their typical use (lectures or tutorials). Lectures can easily be given in videoconferencing systems. There are a variety of these from shareware Internet systems (CuSeeMe) which are low-quality, through to ISDN tools (e.g. PictureTel) which need specialised hardware (approximately 600 ecu for a PC). Lectures may also be delivered as files on a Web page, for the

student to work through, and these may be viewed using a browser. More interactive, tutorial-like sessions may be delivered using computer conferences (e.g., 1st Class, newsgroups) which enable users to send text files to a named discussion group, and to build up a set of interlinked messages in the style of a debate (email can be used to similar effect but does not provide any 'threading' facilities to display how messages are interlinked). Tutorial sessions can be provided by the following methods, all of which provide a high degree of interactivity:

- Web pages: students write their presentations and publish them on the Web or in a conference.
- Videoconferences.
- Whiteboards (built into Netscape) and other applications shared between all the participants.

Table 5.3 Use of telematic components

Computer conferences/ newsgroups	Synch	Asynch	Dist	Homog	Loose	Tight
Videoconferences	✓		✓	✓	✓	✓
Chat: IRC, MS comic chat	✓		✓	✓	✓	✓
Shared applications and whiteboards	✓		✓	✓	✓	✓
Email		✓	✓	✓	✓	✓
Video-on-demand		✓	✓	✓	✓	✓
Search engines	✓		✓	✓	✓	✓
WWW browsers: Netscape/Explorer	✓	✓	✓	✓	✓	✓

Chat programs (such as Internet Relay Chat and MS Comic chat) can provide synchronous discussions in text between multiple users. An additional tool is video-on-demand. Using a Sun video-on-demand server, lectures and tutorials can be videorecorded and sent out on demand to students. Such technology requires good network connections and is beyond the current bandwidth of the Internet (but is possible over private or ISDN lines). Table 5.3 illustrates the types of use to which telematic component tools can best be put.

Once we have produced a course and made use of the appropriate component tools, we will wish to register telematic students and track their progress. This is the domain of tracking tools. A number of tools are

available: WEST (which is Unix-based), TopClass (an NT version of WEST), WebCT (a Unix-based system) and Cafe-Mondial (an NT-based system). The first three are currently commercially available. Cafe-Mondial is under development as part of an EU Telematics programme. The tools provide facilities to enable students to do the following:

- browse through a module catalogue,
- register,
- work through the teaching material,
- undergo assessment,
- inspect their marks, and
- claim credit at participating institutions.

2.3 Summary

An important character of Internet education is the potential for teaching and learning at a distance from a host institution. The consequence of this telematic teaching is that the students may well be unable to come together synchronously as a whole class (for reasons of time or distance). For such students, a key feature of the Internet is its ability to link them together into a collaborating community by means of file-based computer conferences, e-mail and the Web. They can benefit from a richer teaching and learning environment. Furthermore, this environment can include both static information and also active and interactive content in full multimedia format, using Java, Visual Basic, Perl and other scripts as well as ActiveX and Java mini-applications.

While the technology of the Internet is seductive, it is nevertheless important that the technology be used to produce well-motivated, pedagogically sound learning experiences which play to the strengths of the medium. These clearly lie in the facility with which material can be made available, maintained, updated and re-used. The sheer volume of the material available, and the social dimension of community which telematics creates, are strengths in themselves. After all, education is concerned with preparing learners to become fully-fledged participants in a given arena. Participation in education is not only a matter of acquiring knowledge, but also involves acquiring skills in presentation, communication, analysis, debate and discussion. It is in this area that the Internet currently excels. It may not always be appropriate to publish material on the Internet when a book or compact disc would be more practical. However, the Internet is unrivalled for bringing together scattered people in virtual communities for teaching and learning.

3 Speech Sciences Education

3.1 General features of speech sciences education

There are certain features of education in the speech sciences which make the Internet especially suitable as a medium for education While conventional methods will still form the foundation of speech sciences education, it is plain that the Internet can make a contribution that is to be especially welcomed by this field. The particular features of speech sciences education are outlined in the subsections below.

Multiple disciplines

The study of Speech Sciences is inherently multidisciplinary to an unusual degree, and involves elements of linguistics, modern languages, psychology, computer science and electrical engineering, as well as many biomedical areas. Students find the multiplicity of disciplines difficult to manage, since their background rarely prepares them in breadth. No student comes fully grounded in all relevant areas. Additionally, the field crosses the divide between arts and sciences. From the teacher's point of view, this situation complicates the administration and delivery of education, since traditionally expertise in these areas has been distributed across a number of academic departments, each with its own human resources, facilities and tools. Given such a lack of centralisation, the Internet as a medium of communication can help in a number of ways:

- It gives students the means to draw on varied expertise throughout the community, consulting outside tutors and experts.
- It facilitates communication between "virtual" communities of teachers or students working in a particular sub-discipline.
- It enhances quality and reduces a duplication of effort in the creation of teaching materials.
- It encourages the dissemination of good practice among teachers.

Practical skills

The Speech Sciences student needs to acquire practical skills in listening, analysis and performance. In addition, speech and language therapists need to acquire basic clinical skills. This inevitably requires a lot of staff/student interaction at a time when there is pressure throughout European universities to increase efficiency and decrease the use of staff resources. Interactive assessment and peer assessment through the Internet, together with interactive online tutorials, can increase the efficiency of student self-study in these skills.

Multiple media

Speech processing is inherently multimedia in nature, involving both sound and vision. Current printed materials cannot convey the co-ordination of articulation, sound production and sound perception. The Internet standards for audio, video and even three-dimensional models could lead to materials where such interactions become much clearer to the student (in the case of a 3D model of a vibrating larynx, for example).

Extramural interaction

Many students (in modern languages or computer science, for example) find their interests in Speech Sciences cannot be satisfied by their local institution. There are relatively few specialised departments of Phonetics or Speech Science in Europe. Even in larger departments, postgraduate students might find themselves academically isolated because of the specialist nature of their interest. The Internet can allow students to participate at a distance with teachers and experts in other institutions, using the variety of mechanisms for computer mediated communication. In the same way, students can form "virtual communities" using the Internet, and these can be a valuable source of support to students who are academically isolated within a small department. In extreme cases, an extramural tutoring relationship can be set up using the Internet, at least for part of a student's course. Finally, among teachers, the Internet can be a very efficient and cost-effective way of sharing teaching materials and disseminating good practice, to avoid duplication of effort.

Language diversity

Speech Science education should be built on both the universals and the specifics of human languages. The Internet can allow easier access to linguistic resources, tutorial information and native speakers of various human languages, regardless of geographical location. It is true that Web materials are overwhelmingly written in English. However, the Internet also provides the easiest manner of contacting and interacting with native speakers of languages other than English. This would be useful in the case of experiments as part of a class project in phonetics or phonology.

3.2 The Internet versus CD-ROM

Certain of the teaching functions indicated above could equally be provided by a CD-ROM, especially one that was updated frequently. Other functions, however, necessarily require the Internet. The following subsections outline which teaching functions belong in which category.

Teaching resources that could be provided on CD-ROM

CD-ROMs have the advantage of much faster access speeds than the Internet, and less risk of a temporary denial of service due to network failure. There is also less of a virus threat, since the manufacture of a CD-ROM can be closely controlled. Also, sending out CD-ROMs means that the originator's computers are not at risk from unauthorised access. The following teaching functions could be successfully implemented using CD-ROMs.

- ***Intensive training in practical phonetics***. This is a very clear case where computer-aided learning would be useful. Students require intensive practice which traditionally has been facilitated by specialist phoneticians, at great cost in staff time. Much of this practice could be done by students working with self-study modules. Staff input would be required only occasionally, to correct and check the individual student's efforts.

- ***Multidisciplinary tutorial materials***. This is another clear case of the advantages of computer-aided learning. Tutorial materials on CD-ROM could draw together elements from several different fields which may otherwise not be easily accessible (e.g. physics and anatomy, in a module on the perception of sound).

- ***Multimedia presentation of materials***. While a few multidisciplinary textbooks exist, CD-ROMs have the advantage that sound and animation can be added in order to make the principles clearer to the student. Figure 5.1 is an example of what can be done using CD-ROM. It is taken from the demonstration version of the "Sound" module of the PsyCLE software, which was funded by the UK Higher Education Funding Councils' "Teaching and Learning Technology Programme". Further details are available at [URL1].

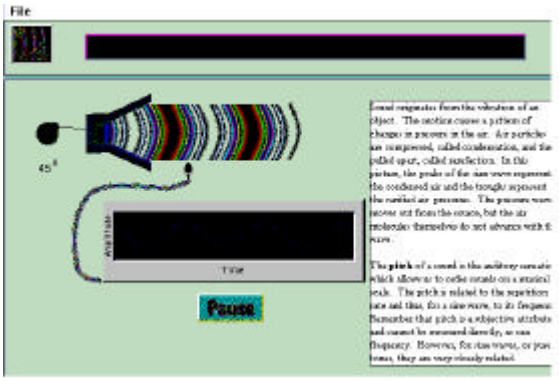

Figure 5.1: This screenshot has animation at two places: the panel showing alternating waves of compression and rarefaction, tied to a rotating object (with degrees of arc indication, changing synchronously); and the sinusoidal waveform in the display panel underneath, which changes in synchrony with the other display.

Teaching resources for which the Internet is needed

- ***Access to world experts***. If a student (especially a postgraduate student) wishes to consult an expert about a question for which no expertise is available locally, then the Internet is much the fastest (and cheapest) method of doing so.

- ***Access to fellow-students***. For an academically isolated student, the Internet provides access to a "virtual learning community" of other students of the same subject, for mutual support.

- ***Access to native speakers***. If a student seeks native speakers of another language for a project, then it may be possible to use the Internet to contact them, much more easily and cheaply than would be possible by traditional means. However, recording native speaker utterances over the Internet may not yield sufficiently good sound quality for phonetics experiments.

- ***Access to research on foreign languages***. A large amount of reference material is available over the Internet. In the case of foreign languages, it may be difficult for the student to find the desired information locally, and this is where the Internet could be of use.

- ***Access to tutors***. For students unable or unwilling to attend higher education institutions, the Internet can provide a convenient means of access to tutors.

- ***Videoconferencing and transmission of recorded lectures***. An obvious use for the Internet is in videoconferencing between students (such as when engaging in a "virtual tutorial"), or in the multicasting of recorded lectures. At the moment the latter requires specialist high-speed connections and equipment.

- ***Access to fellow-tutors to share good practice***. Among university teachers, the Internet can be used to share teaching materials and to disseminate good practice. This is already being done, in the UK, by Government-funded initiatives such as the "NETPhon" network.

Current bottlenecks in Internet provision

Many of the possibilities mentioned above cannot come to full fruition until the technology matures sufficiently to implement them, or until existing technology becomes much more widespread and accessible. There is also, naturally, a question of funding, as much of the requisite technology is expensive. Although computer-aided learning will save on staff costs in the long term, the initial costs are a barrier to full

implementation in some cases. The subsections below outline some current technical barriers to provision.

- ***Limited access to MBONE technology***: The MBONE is a technology for broadcasting on the Internet suitable for viewing transmitted lectures. Since it is not yet widely available, very little has actually been made of its potential.

- ***Limited bandwidth***: Even using the higher capacity portions of the network (the UK Universities high-speed network, SuperJANET is capable of 34 megabits per second) the speed of transmission is not sufficient to support some of the applications outlined above. In view of this, the Scottish Higher Education Funding Council has recently funded four "Metropolitan Area Networks" capable of 155 megabits per second. These four interconnected MANs cover most Higher Education Institutions in Scotland, and use the new Asynchronous Transfer Mode (ATM) technology.

- ***Real-time audio***: This is currently available using client/server architecture and proprietary compression formats (e.g. RealAudio from Progressive Networks: details at [URL2]). However, the use of this technology is not yet widespread. Since whole radio programmes and lectures can be made available for listening over the Internet using this technology, it is an important building-block for the educational use of the Internet.

- ***Real-time video***: There is also a need for real-time video using compression software, for use over existing connections (e.g. RealPlayer from Progressive Networks). This technology is currently adequate for lectures etc, but possibly not for detailed phonetic demonstrations, where greater visual clarity is required.

Support programmes for Computer-Aided Learning

There are various support programmes and networks available, particularly in the UK, for Computer-Aided Learning. These are in two main categories: general CAL programmes (supporting the development and use of CD-ROM material), and programmes that focus on the use of the Internet. The principal UK programmes are outlined below; we hope to collect similar information from other European countries in future years.

General CAL support programmes for higher education

- ***Teaching and Learning Technology Programme (TLTP)***: This programme is funded by the UK Higher Education Funding Councils to support the development (by staff consortia or by single institutions) of

a large amount of software available at minimal cost to UK HE institutions. Details are available at [URL3].

- ***Computers in Teaching Initiative*** (CTI): This programme is funded by the UK Higher Education Funding Councils to facilitate effective use of computers in Higher Education through the provision of information on technology to support educational change. Details are available at [URL4].

- ***Learning Technology Dissemination Initiative*** (LTDI): This programme is funded by the Scottish Higher Education Funding Council to support and encourage academic staff in the integration of technology into teaching and learning. The focus is on delivering material to where it can be used. Details can be found at [URL5].

- ***Teaching and Learning Technology Support Network***: This network evolved out of the Teaching and Learning Technology Project. It supports institutions in all aspects of institutional policy relating to the use of learning technology, and thus serves to complement the more "classroom-based" expertise of the Learning Technology Dissemination Initiative. Details are available at [URL6].

Support programmes focussed on the use of the Internet

- ***UMI: Use of MANs Initiative***: This is a series of projects funded by the Scottish Higher Education Funding Council to develop educational applications which exploit the speed and bandwidth available on the Scottish high-speed Metropolitan Area Networks. Details are available at [URL7].

- ***TALiSMAN: Teaching And Learning in Scottish Metropolitan Area Networks***: This project is funded through the Scottish Higher Education Funding Council's "Use of MANs" Initiative. It aims to deliver high-quality training on the most effective use of MAN technology to the academic community in all Scottish HE institutions. Details are available at [URL8].

- ***NETPhon: Network for education and training in phonetics***. This was established in 1994 and initially funded by the Department for Education and Employment. The network held meetings and sponsored the electronic discussion list "Phonet". Details of its activities are available at [URL9].

- ***eLib: the Electronic Libraries Programme***. This is funded by the Joint Information Systems Committee of the UK Higher Education Funding Councils. It aims to pave the way towards the fully electronic academic library of the future. Details are available at [URL10].

- ***Netskills: Network skill for the UK Higher Education Community***. This programme aims to help the UK Higher Education community to make effective use of the Internet for teaching, research and administration. It is part of the Electronic Libraries Programme (eLib). Details are available at [URL11].

3.3 Prototypes of Internet-mediated speech sciences education

The subsections below give examples of Web pages which offer working prototypes for what can be expected in Web-based speech sciences education. Each field is considered separately: phonetics/phonology, spoken language engineering, and speech/language therapy.

Phonetics and Phonology

Education in phonetics and phonology involves such practical skills as the phonemic transcription of utterances, and the ability to interpret the information in a sound-spectrogram. Both these skills require extensive practice, which is expensive in terms of staff time, and this is where computer-aided learning can be of particular assistance.

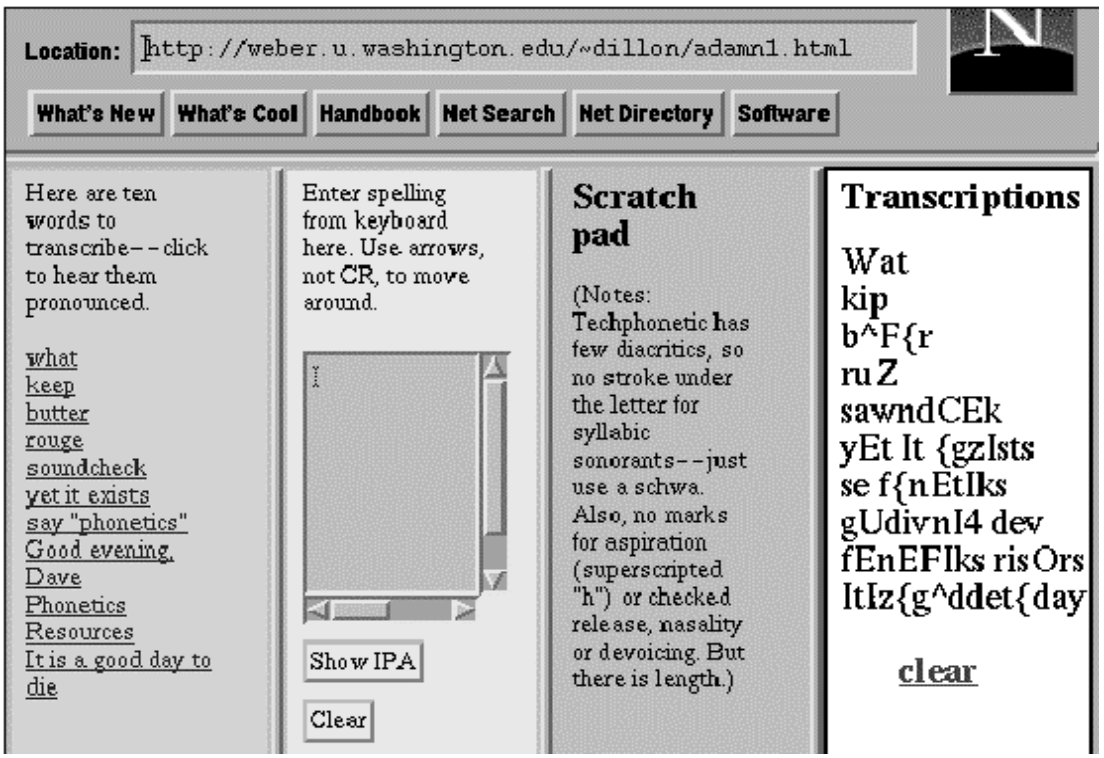

Figure 5.2: This screenshot (above) is an example of a Web page with online transcription practice and self-testing [URL12]. The first column gives words for transcription, with the chance to hear the recording. The second is for students'

transcriptions. The third provides phonetic symbols, and the fourth column, when clicked on, shows the correct answer.

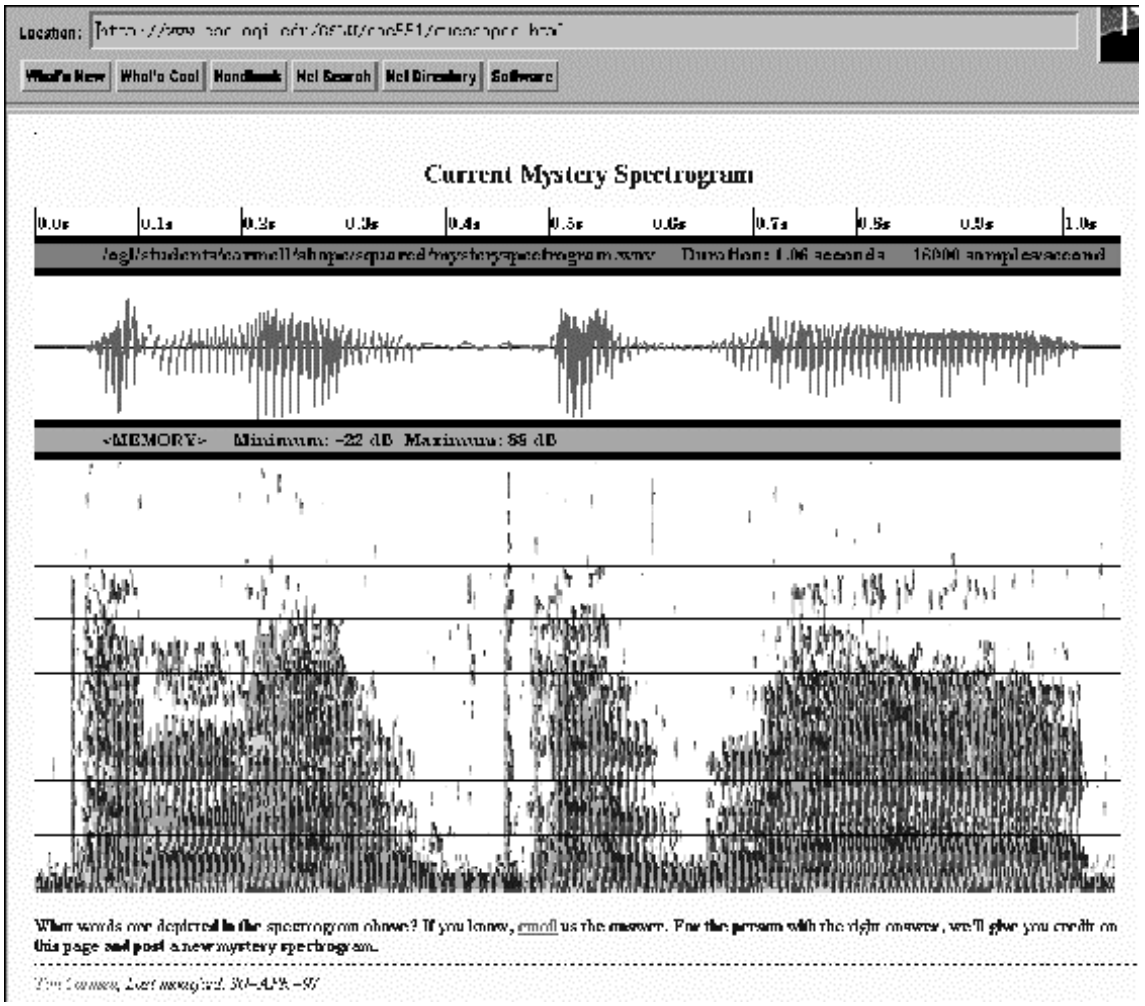

Figure 5.3: This screenshot (above) is a "mystery spectrogram", where the student must read the spectrogram and determine the utterance [URL13]. The first successful student is given credit by placing his/her name on the page together with the correct answer, and a new spectrogram is then provided. This page adds the incentive of a small competitive element to this classic training technique in acoustic phonetics.

Spoken Language Engineering

Education in spoken language engineering demands a detailed understanding of acoustics and relevant applied mathematics, together with a practical understanding of speech technology applications. The screenshots below are examples of the possibilities available in these areas, both interactive and non-interactive.

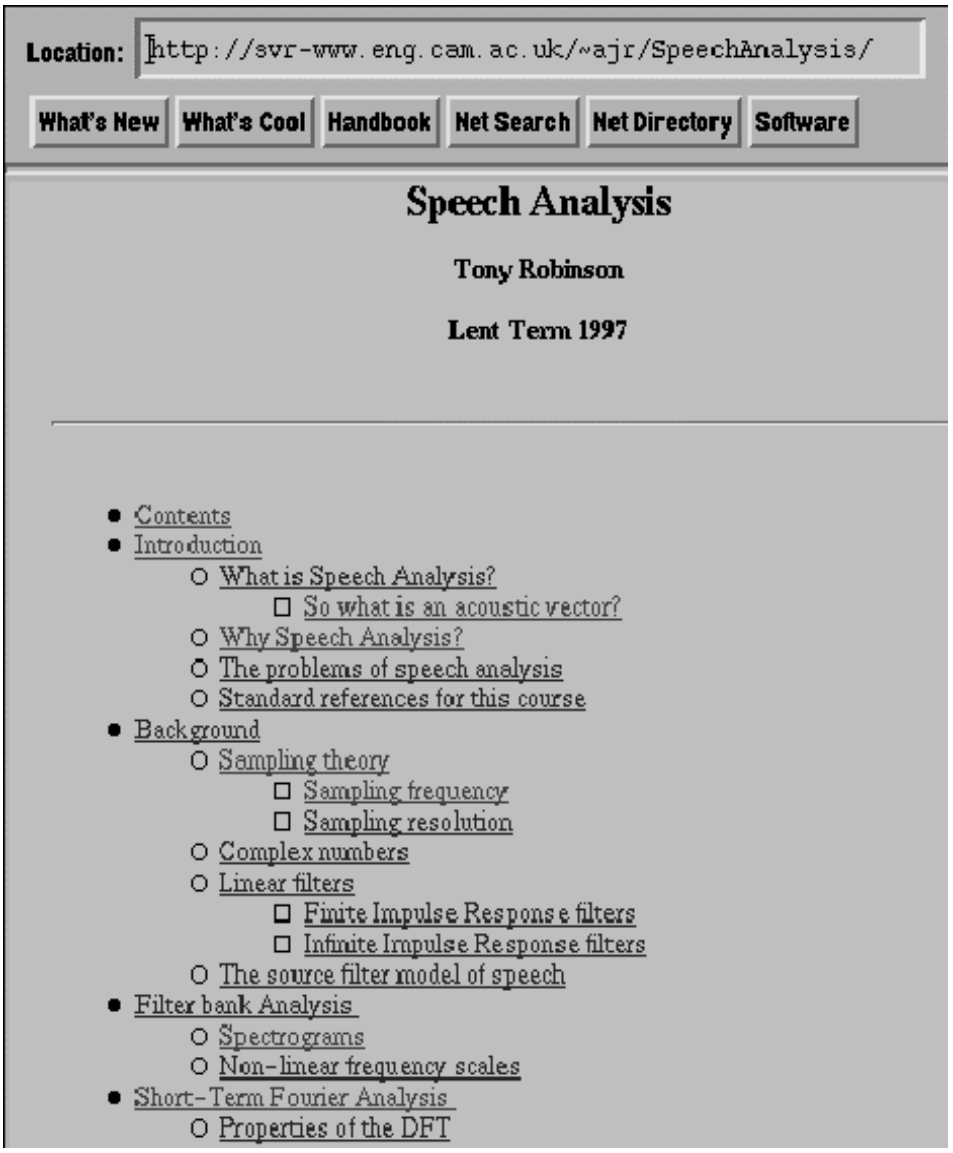

Figure 5.4: The simplest application of Web technology is the provision of text material, such as lecture notes, in hypertext form. This screenshot (above) shows a particularly detailed set of notes in the field of speech analysis [URL14]. This mode of publication might form a component of a "virtual university" where most or all of the teaching is conducted over the Internet. There will always be a place for non-interactive reference material of this kind in any Web-based course.

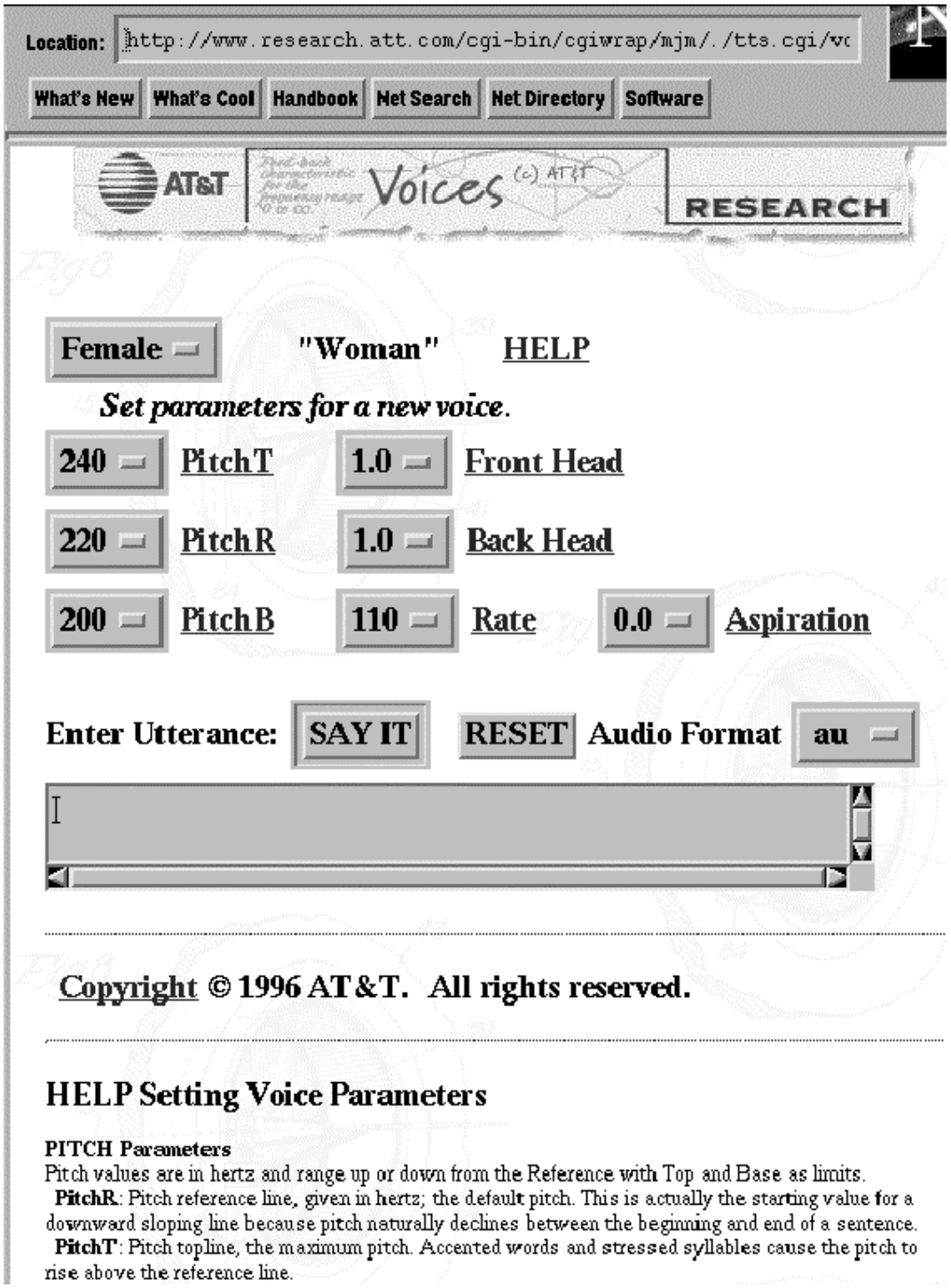

Figure 5.5: This Web page allows the user to type in arbitrary English text and submit it to a text-to-speech synthesiser at AT&T Research [URL15]. The synthesised speech waveform is then sent to the user immediately, and can be listened to if the appropriate hardware is installed. The user has a choice of several pre-set "voices", such as 'male', 'female', 'child', 'raspy', 'gnat'. However, what is of more interest from the point of view of education is the fact that the user can alter the main parameters of the voice and listen to the result. This will allow the student to gain practical insight into the effect of these parameters on a synthesised voice. This is a vital prerequisite to advanced education in speech technology.

Speech and Language Therapy

The field of speech and language therapy is not yet as far ahead as the other two fields in its use of the Internet. Therefore the examples below are taken from a different (but related) field, as an example of the kind of Internet-based education appropriate for the development of clinical skills in students at an early stage of their professional training.

Figure 5.6: The "Interactive Patient" has been developed at Marshall University School of Medicine [URL16]. It is a study of a consultation with a patient with acute backache. The student first asks questions to learn the history of the complaint, with answers made available at once. On a later page, the student "examines" parts of the patient's body by clicking on images of it, with the results returned at once. The

student can also specify certain laboratory tests and X-rays, the results of which are made available in detail.

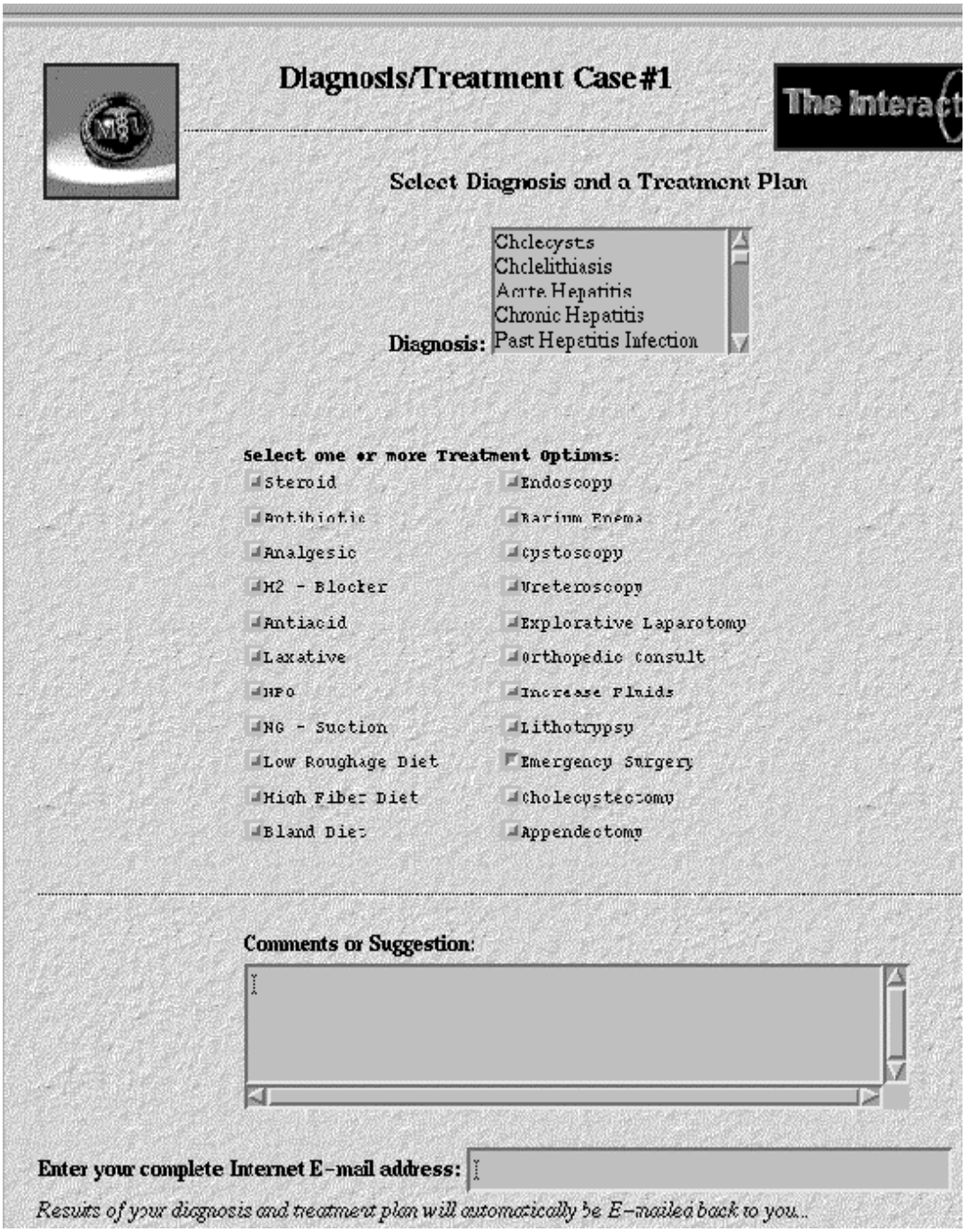

Figure 5.7: Once students are confident that they can diagnose the condition, they choose from a menu and then prescribe treatment from another menu. Their choices are emailed to the site, which will email the student with a note of how correct their answers were. This kind of software could be adapted to simulate a clinical encounter in speech therapy, for example the measurement of a child's hearing. In this way, novice students would be enabled to learn correct procedures in an inexpensive way, before practising on real subjects. Another advantage of this simulation is that it is not necessary for the students to have access to expensive specialised hardware for use in practising their clinical skills. Thus it could be used as part of a distance learning module over the Internet.

3.4 The shape of things to come?

An even more radical development would be the use of the Internet as the primary medium of education. The following screenshots are examples of two fledgling projects with this aim. The Clyde Virtual University focusses mainly on proving the technology in a few prototype fields (such as a Web interface to student newsgroups for email conversations sorted by topic). On the other hand, the University of the Highlands and Islands aims to establish a new university, focussing on the actual delivery of education rather than simply testing software.

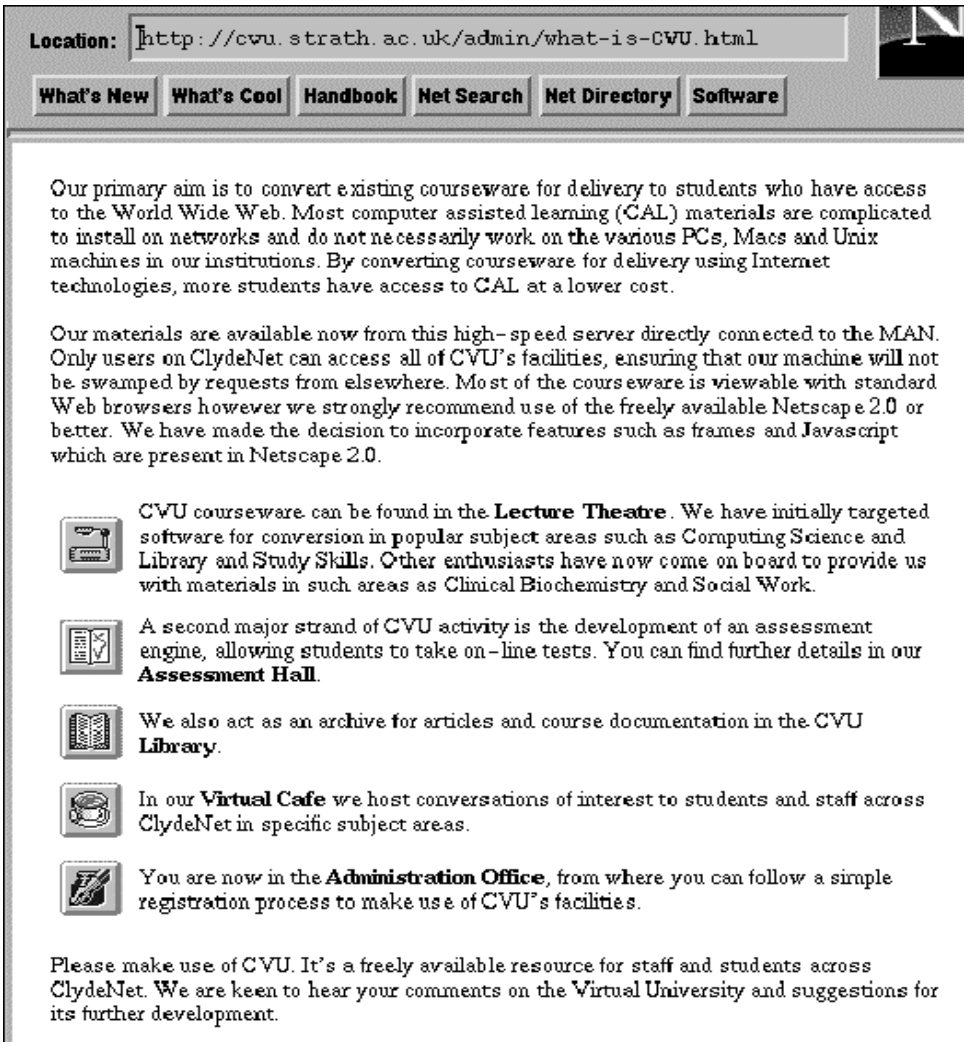

Figure 5.8: Clyde Virtual University is one of the projects funded by the SHEFC's "Use of MANs Initiative" (see 3.2 above). Its aim is to develop the software necessary for a virtual university, and to evaluate it in use by providing prototype applications for use by student subjects. Several different kinds of software must be integrated, and

this screenshot indicates the various functions that are expected of a virtual university: courseware and tutorials, assessment, reference material, inter-student interaction, and student registration and tracking. This page is at [URL17].

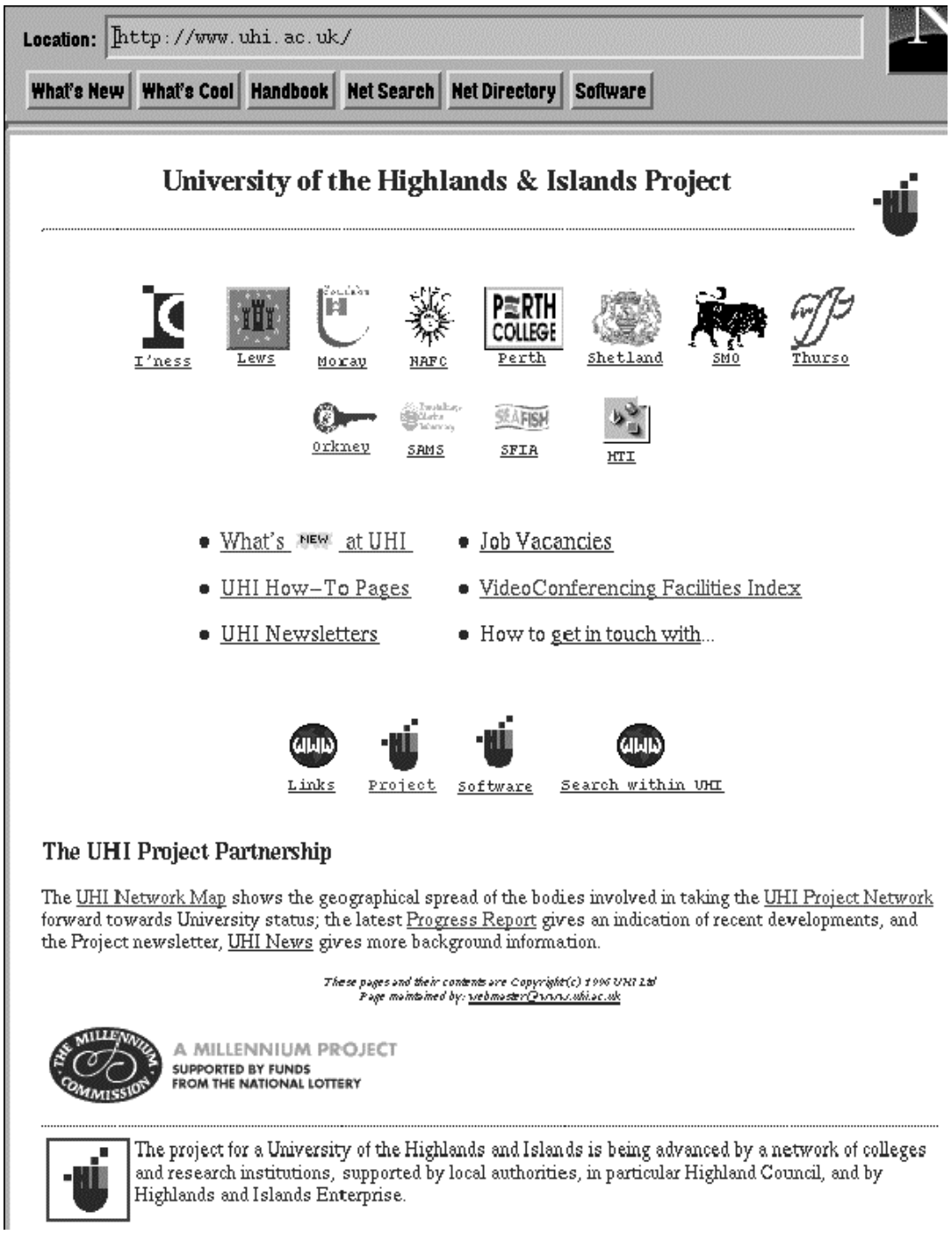

Figure 5.9: The University of the Highlands and Islands is an embryonic project composed of several further education colleges in Scotland. It is the first real attempt to create a virtual university, and at the moment it is in the preparation stage. It is closely tied to local needs and employment opportunities, but hopes eventually to include a wide range of academic subjects. It is made possible partly by the rare combination of a very low population density (in the north of Scotland and offshore

islands), a very high level of educational and technological development (in the UK as a whole), and the installation of high-speed telecommunications links (in this area of Scotland). The UHI is funded partly by the UK's Millennium Commission, and partly by local authorities. This Web page is at [URL18].

4 Survey of Internet Resources

Between February and June 1997, the working group surveyed Web sites world-wide for educational resources relevant to Speech Sciences. A Web-based questionnaire was used to collect details [URL19]. The contents of the inventory are published on the Web on a regular basis. It can be viewed at [URL20].

From a study of the range of resources in the inventory, the group has developed a set of nine categories to describe the types of educational resources currently available on the Internet. In the sections below, we give a brief description of each category and describe one or two resources to give more indication of the type of material available. A more complete list of resources found under these headings is given in the Appendix.

4.1 General information

In this category are documents relating to how the Internet may be used to deliver teaching and learning. These cover the pedagogical opportunities and problems arising from the use of the internet, to discussions of the individual technological services.

An example is the paper "Delivering Instruction on the World Wide Web" by Thomas Fox McManus from the University of Texas at Austin [URL21]. In this paper McManus discusses the advantages and disadvantages for using the Web for instruction delivery, and reviews the technological support for authoring materials. In addition McManus also discusses how theories of instruction could play a part in the design of the materials. In the instructional systems design model, the materials are designed in terms of a set of desired 'behaviours' expected of learners once they have completed the course. In the Cognitive Flexibility model, materials are organised into a web of instructional sequences that are anything but linear, to accommodate the different requirements of individual learners. This hypermedia delivery is, of course, well suited to the technology of the World Wide Web.

In a related paper, "Some considerations for Designing Internet Based Instruction", [URL22], McManus makes the comment:

> "The internet can deliver video, but not as quickly as videotape, television or CD-ROM. It can carry real-time personal

> interaction, but not as well as telephone or video conferencing. It can display textual information, but not as usefully as a book or magazine."

Why then should the Internet be useful for educational materials? McManus replies:

> "It combines advantages of other media so that it conveys video and sound better than a book, is more interactive than videotape, and unlike CD-ROM, it can link people from around the world cheaply. The second advantage, and one that is often overlooked when discussing the Internet as a delivery system, is that it can also be a content provider."

4.2 General Tools

In this category are Internet accessible tools to aid in the delivery of tuition: both in terms of computer-based and internet-based technologies. This ranges from tools for authoring and interactive assessment to complete environments for the creation of telematic courses.

An example is the WebCT package [URL23] that covers student tracking, assessment, chat, discussion groups and e-mail as well as course material. Although not many course development tools of this kind exist at present it is likely that any such tool will be similar to WebCT in terms of general structure, although details may be varied infinitely.

WebCT is a tool for creating a web-based educational environment. It may be used to create complete on-line courses or supplements to existing courses. Interaction with WebCT is through any of the existing web browsers and all content is in the form of HTML documents. The server on which WebCT runs must, however, be running the UNIX operating system. A wide variety of UNIX dialects are supported.

A course is organised around a home page with entry points to other components (exercises, chat, notice boards, quizzes etc.). There are four levels of users: administrator, designer, marker, and student. The administrator sets up the system, the designer constructs a specific course and, markers administer tests and quizzes. The system contains tools for student tracking and a simple tool for presenting results in the form of histograms. Any course material, experiment etc. which is either in the form of a HTML document or a program written in the Java programming language may be part of WebCT. Material in any other form necessitates leaving WebCT. A course on acoustic phonetics, for example, would require students to work with acoustic analyses outside WebCT. In

such a case the web course would serve as a complement to other forms of teaching material. All this may change, of course, if new programs for acoustic analysis etc. are developed in the Java language, but at present such programs do not exist.

It is estimated that the program will be released in August 1997. At the time of writing (June 1997), the tool was not available as a commercial product, but only accessible to those accepted as beta testers.

4.3 Tutorials

This category is for educational materials relevant to the Speech Sciences theme, which are directed at the student. They can cover both large and small topics, from complete tutorials in Phonetics and Phonology, to a discussion of the principles of spectrography.

An example is a tutorial on acoustic-phonetics [URL24] developed by H.G. Tillmann and F. Schiel of the Ludwig-Maximilians-University in Munich. The tutorial is basically a text-based course, divided into four chapters. Each chapter ends with a few questions on the topics covered in text. Suggested answers are linked to the question sections. From this point of view the tutorial is not much different from a written text. The tutorial makes use, however, of one of the advantages of electronic media – the possibility of linking non-text material to the text as illustrations. Thus there are several sound clips linked to the text, illustrating various aspects of sound qualities. The reader may listen to these sounds by simply clicking on a button as illustrated in Figure 5.10.

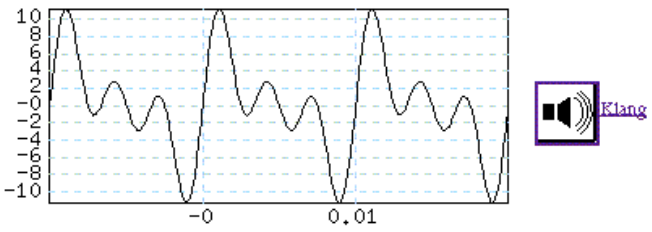

Figure 5.10. One of the advantages of hypertext tutorials is the possibility of linking various non-text material to the text. The Figure shows a diagram of a complex wave form. By clicking on the button to the right, the reader may listen to the sound produced by this wave form. The illustration is copied from a tutorial by H.G. Tillmann and F. Schiel of the Ludwig-Maximilians-University in Munich [URL24].

The possibility of linking sounds to the text is, of course, of particular interest in the field of phonetics. This is true for acoustic phonetics as illustrated above, but also for phonology, foreign language acquisition and for many other topics. Several tutorials linked to the data base use this option. A further example is a tutorial on auditory perception [URL25] which is richly illustrated with sound clips.

Using the Java language capabilities, it would be possible to include actual experiments in the text. However, no tutorial that the authors have come across utilises this option. It is also possible to include animated graphics and video clips. This would be particularly useful in connection with texts on articulatory phonetics and aspects of non-verbal communication, and bi-modal communication including visual and auditory cues. A demonstration of audio-visual speech synthesis [URL26] may serve as an example, although it is not primarily intended as a tutorial, but as a description of research work on audio-visual speech synthesis conducted at the ICP institute of the University of Grenoble. By clicking on links, the reader may load video clips illustrating various aspects of audio-visual synthesis. The synthetic head used in some of the demonstrations is shown in Figure 5.11.

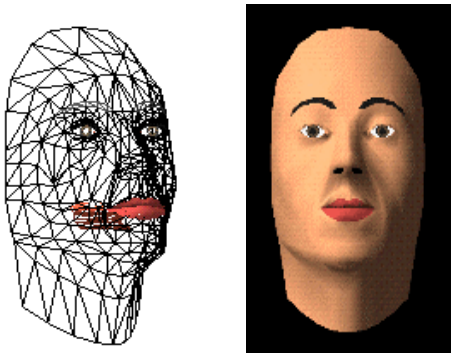

Figure 5.11: The figure shows a wire mesh model of a human face and the synthetic face, based on the model, used in the audio-visual speech synthesis project conducted at the ICP institute at the University of Grenoble [URL26].

The usefulness of video clips and other than short sound clips is at present somewhat limited by bandwidth. The file size of the video illustrating the 'talking head' mentioned above is about 1.5 Mb. On slow networks this may be a severely limiting factor.

4.4 Component Resources

In this category are smaller educational resources that could be included in tutorial material, but which are not currently suited to student self study.

A typical example is a recreation of the sights and sounds of the Haskins pattern playback machine [URL27]. The now classic pattern playback system was developed in the fifties at Haskins laboratories. The Web pages contain a fairly detailed description of the system and several sound clips to illustrate the sound quality of the synthesis. This component may be a valuable illustration in any course on speech

synthesis, but also as an illustration of a technique which has played an important role in many classical perception experiments.

Another example [URL28], also from Haskins, illustrates the principles of articulatory speech synthesis. The different steps in the synthesis of a set of vowels are shown – vocal tract shape, area grid, area function, spectrum of the sound. The resulting sound may be listened to by clicking on a button. At present, the system can only produce static vowels, but work is in progress to enable the synthesiser to simulate dynamic processes as well. Diagrams showing two of the synthesis steps are shown in Figure 5.12

As was mentioned above, use of the Java language makes it possible to run actual experiments via a web browser. Programs written in the Java language may be loaded and run using a Java enabled browser. An example of this kind of usage of the web is a demonstration of categorical perception produced by one of the authors [URL29].

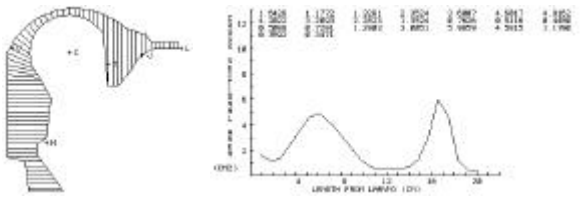

Figure 5.12: Two diagrams illustrating steps in articulatory speech synthesis. The left panel shows a vocal tract with grid lines used in calculating the area function, which is shown to the right.

A categorical perception test consists of two parts – a categorisation test and a discrimination test. If perception is to be classified as categorical it is necessary for subjects to classify stimuli chosen along a continuum into a limited number of categories, normally two or three. It is further required that discrimination should be considerably better across categories than between them. The demonstration is a complete test for categorical perception. After each part of the test, the result is presented in the form of a diagram (see Figure 5.13).

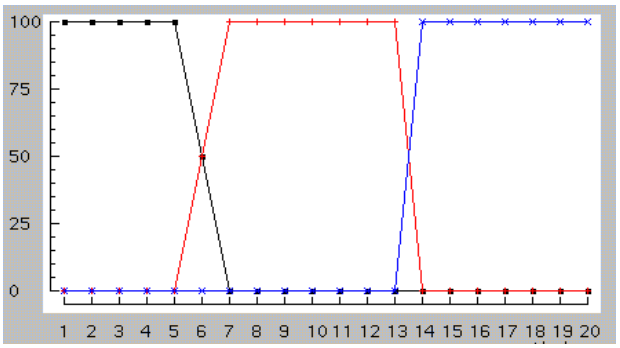

Figure 5.13: The figure shows a diagram illustrating the result of the classification test, which is part of a categorical perception test.

It is a demonstration rather than a scientific experiment only in the sense that in an actual experiment one would require the subjects to listen to a greater number of stimuli. There is, however, no reason why this technique could not be used also to perform real experiments.

As far as the authors are aware, this demonstration is the only resource of its kind, but it seems likely that with the development of the Java language and subsequent wider use of it, one may see many more programs of this type in future. One obvious advantage is the relative platform independence. Browsers which run Java applications exist today for all major platforms.

The examples described here may be used as components in relevant courses. The advantage of components over complete courses is, of course, that they permit teachers to compose their own syllabi freely and only use what components they see fit for a particular course.

4.5 Course Syllabus Information

This category includes descriptions of the syllabus or curriculum for courses in the field of Speech Communication Sciences. At their simplest, these 'course home pages' contain lecture lists, reading lists and assessment details; at their most complex, they include interactive activities and links to related materials. Eventually, these will develop into complete automated distance learning or 'telematic' courses. In their current form they may be of more interest to teachers than to students of other institutions.

A good starting point on the Web for these materials is the 'World Lecture Hall', a hyperlinks page of references to courses world-wide that are using the Web to some degree to deliver class materials. While the material seems to be almost entirely in English and with a mostly U.S.A. representation, the reference page for Linguistics [URL30] contains useful examples of the range of Web materials currently used in this

way. A course on the Human Instinct for Language investigates the 'innateness hypothesis'; a course on the French language provides the equivalent of introductory textbook in French linguistics; a course in Literary Stylistics is based in Singapore; a course in Computational Linguistics contains complete lecture notes.

We look in more detail at the course materials provided by Robert Beard of Bucknell University in the U.S. called 'Linguistics 105 - Sounds and Words' [URL31] since it contains some phonetics/phonology components. The self-styled 'on-line interactive syllabus' contains

- Course objectives
- Course management and organisation
- Course grading
- Course reading
- Course schedule with lecture dates, titles, readings and assignments.
- Glossary with self-study testing
- Linguistics lexicon
- Phonetics fonts
- Links to on-line grammars
- Links to pictures of saggital cross-sections of various articulations
- On-line quizzes on consonants, vowels and saggital sections
- Videos on chimpanzee language, wild children, the origins of language

4.6 Bibliographies and Refereed Articles

This category refers to on-line bibliographies and published articles. Advanced students need access to descriptions of current research of ensured quality. Thus this category relates to the access to published papers from accredited sources.

Scientific Journals are more and more concerned with electronic access, text retrieval, and maintenance of digital archives. Also book editors think increasingly to make their book available in a digital form, either on the internet or on CD-ROM. In addition, most of today big conference offer either printed proceedings and/or CD-ROM; and some conference proceedings are partly or entirely available on the network. Below, we give some examples of what is available today in the area of Speech Sciences and Technology.

A few books are already entirely available in a browsable format on the internet, e.g., *Survey of the State of the Art in Human Language Technology*,

R. Cole et al., Eds. [URL32], or the *EAGLES guidelines*, N. Calzolari & J. McNaught, Eds [URL33]. Beside the fact that these books are free of charge and available very quickly after final editing, they offer the incomparable facility of cross-references as links to other sites on the network. Unfortunately, such initiatives are still infrequent. However, it is getting more common to find entire doctorate theses on the network, even before they are defended in some cases.

Today, many books are published with accompanying CD-ROMs on which the articles are often retrievable. More interestingly, these CD-ROMs often include audio files or even movie files that cannot be published "on paper", for example: *Progress in Speech Synthesis*, J. van Santen et al., Eds, Springer-Verlag, 1996. It is also more common for technology books to have an associated Web site where the reader can get updated information after the publication.

Similarly, conference proceedings now appear more and more on CD-ROM. The objective here is twofold: through CD-ROMs, organisers of "big conferences" can produce proceedings more cheaply, and CD-ROMs are a more manageable medium of communication for a thousand 4-page articles. In this case too, it often happens that articles contain links to the authors' homepages, thus allowing newer data to be accessible. In Speech Sciences, the proceedings of the ICSLP'96 (Philadelphia, USA) and of the Eurospeech'97 (Rhodes, Greece) are published in both formats.

Also, some organisers make proceedings available to the public through the internet even before the conference itself, thus allowing the participants to come ready to the conference after having read the papers (e.g., the ESCA Workshop on 'Audio-Visual Speech Processing', Rhodes, Greece, Sept. 97; [URL34]).

There are basically three approaches to "electronic publication" of scientific articles in academic journals.

First is the digital storage of archives. In that vein, the 'Journal of the Acoustical Society of America', for instance, now offers CDROMs where (even very) old articles have been scanned and stored. This is certainly a rather cheap and convenient way to get the entire collection of past issues of the JASA. However, the texts are simply scanned so that text retrieval is impossible on such CDROMs.

Second, electronic files may be accessible through the internet to help understanding or to illustrate articles which are published in a paper format. The URL addresses of accompanying files, whether audio or movie files, now appear in the *Speech Communication* Journal since beginning of 1996. Those files are publicly available from [URL35]. Also,

a searchable table of contents is available under condition of subscription to the Journal.

Third, a few journals are based on a complete and free access through the web. This is the case of two relatively recent initiatives, one by ESCA and ELSNET: The 'WEB-SLS' *Student Journal* (dedicated to PhD students) at [URL36] where three articles have been published in six months. Also, the *Free Speech Journal* (R. Cole et al., Eds [URL37]) published has three articles since it started six months ago.

Finally, there are a few searchable databases where references to articles may be retrieved from information about author, title content, etc. See for instance the Frankfurt Online Bibliography in Phonetics / Speech Technology at [URL38].

4.7 Links pages and other non-refereed articles

This category is for collections of links to relevant material, which may be useful for researching particular topics. They often lead to descriptive material about 'state of the art' or research activities. Since such materials are not refereed, they can be of variable quality.

A major class of reference material found on the Web, and suitable for student use are the "links of links" pages. These tend to be organised around some theme and provide a large number of links to relevant web sites. Since URL addresses change quite often, and because new pages appear every day, these pages can get out of date, so it is important that their maintenance is taken seriously. The content of these pages seem to be selected according to two main criteria. One criterion is the membership to an association or partnership of a project (e.g. see the ESCA list of labs [URL39], although this page also gives links to non ESCA-member laboratories.). A second criterion for selection in a list of referred links is based on the scientific topic. General themes can be found like "phonetics" or "linguistics" where links are often classified according to the alphabetic order of the country (e.g. the University of Amsterdam list at [URL40]). There are also lists of more focused topics, like "speech recognition", "speech coding", "lipreading", "facial animation", etc. (e.g. [URL41] or [URL42]).

4.8 Speech Science Data

This category includes acoustic, phonetic and linguistic materials accessible over the Internet and suitable for educational purposes. Currently the area is dominated by large corpora, and few have the capability for downloading samples without copyright restrictions and free of charge.

Among advertised CD-ROMs (or floppies), we may highlight the UCLA databases (the "sounds of the world" database and the UPSID database at [URL 43]). There is also a Web presence for the big speech corpus providers, mostly set-up for speech recognition training, see the catalogs of the European Languge resources Association [URL44] and U.S. Linguistic Data Consortium [URL45].

Beside these lists of existing materials available for a fee, some free examples can be found. For historical purposes, "speech museums" can be worth visited. Speech synthesis is ideally suited to this kind of presentation, with stored examples or links to on-line synthesizers. These may allow the user to download existing material or to generate their own sentences - possibly exposing flaws in the authors' presentation of the system. See the Museum of Speech Synthesis at [URL 46].

4.9 Speech Science Tools

This category relates to software for speech and language analysis suitable for educational use. There are many more references to such tools on the Web than there are sites from where tools may be downloaded free of charge.

A number of sound tools are freely available from the SimTel archive [URL47] covering MS-DOS, Windows 3.1 and Windows 95 systems. These tend to be either free or 'Shareware' applications, which require a registration payment only if you find the program useful. An interesting 'Freeware' program is the Spectrogram program written by R.S.Horne [URL48]. This program will display real-time spectrograms on any reasonably fast Windows computer. However it has only primitive control over the spectral analysis parameters, and only generates narrow-band equivalent spectrograms for speech sampled at normal rates. The display can be seen in Figure 5.14.

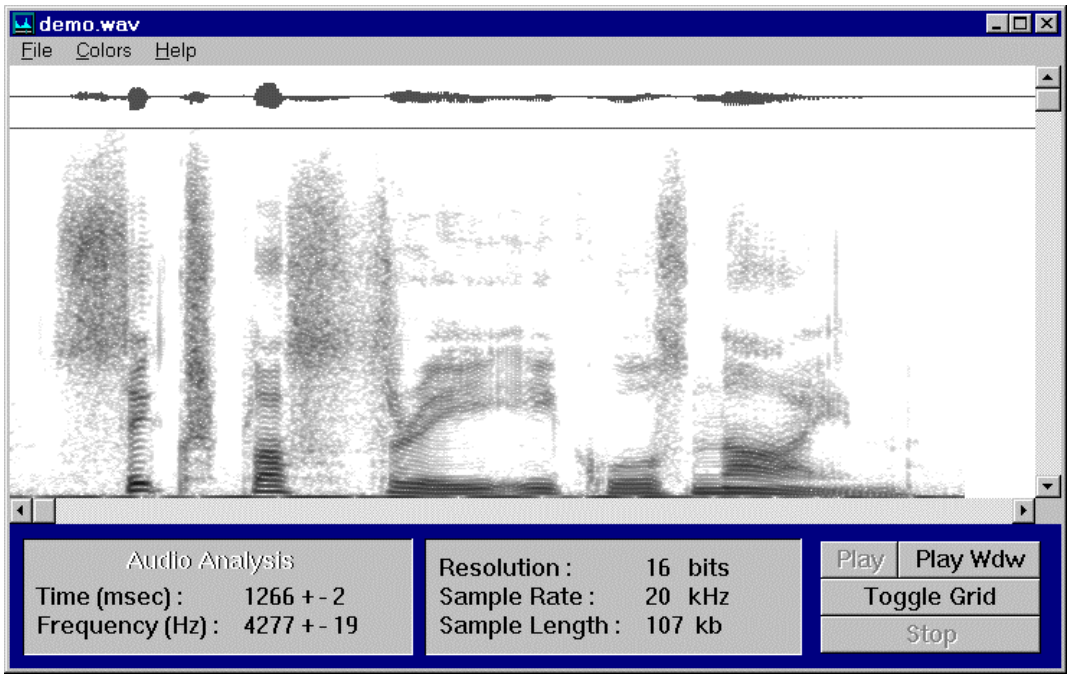

Figure 5.14. Display from the Spectrogram program of R.S.Horne [URL48].

One of the authors of this chapter is also the main author of a suite of speech analysis software, the Speech Filing System, available for free download [URL49]:

> "SFS provides a computing environment for conducting research into the nature of speech. It comprises software tools, file and data formats, subroutine libraries, graphics, standards and special programming languages. It performs standard operations such as acquisition, replay, display and labelling, spectrographic and formant analysis and fundamental frequency estimation. It runs under Unix and DOS environments and is currently running on Sun, Hewlett-Packard, Masscomp, Alpha, Linux and 486+PC. SFS is copyrighted University College London, but is currently supplied free of charge to research establishments for non-profit use. SFS is supplied *as is* with no warranty or support."

Within SFS are the following tools useful for teaching purposes. *Es* is a program that can display speech signals with a time-aligned wide-band spectrogram calculated 'on the fly' as the user scrolls left and right and zooms in and out. It can also print spectrograms to postscript printers. *Espect* is a program to display a time waveform or wide or narrow spectrograms along with a spectral cross section chosen by the user; displays can also be printed to postscript printers; see Figure 5.15. *Esform* is a program like Espect but which uses an LPC modelled spectral cross section to help with formant analysis. *Sprint* is a program to print spectrograms over multiple pages in a standard format of time waveform,

narrow-band and wide-band spectrogram; postscript printers only are supported.

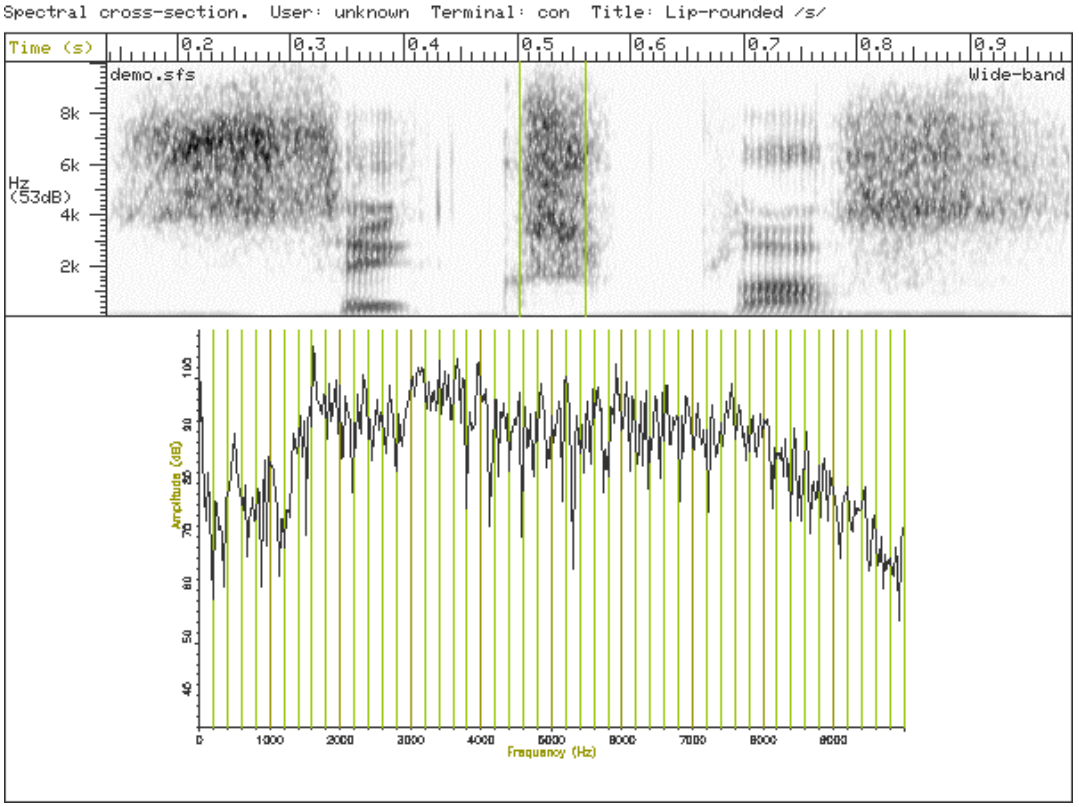

Figure 5.15: SFS program Espect displays a wide-band spectrogram and a cross-section. It is specifically designed for use in speech science laboratories. [URL49].

5 Reflections on the Current Position

In this section we reflect on the properties of the different resources we find in our survey. We consider their coverage, their quality, and issues about data, tools and copyright.

5.1 Coverage

As may be expected in a new and developing field, the material in the inventory suffers from many kinds of biases with respect to language of instruction, geographical distribution and subject areas covered.

Language of Instruction. The overwhelming majority of the material is in English and although there will be some bias due to our collection procedures, the bias to English is very striking. While the dominance of English on the Internet in general probably originates from the technological domination of the U.S., there are probably other influences on the educational resources we have discovered in Europe. These include the use of English as the lingua franca for scientific discourse in the field, and the wide acceptance of English as a second language in

the Scandinavian countries. Other languages in the inventory are currently German, French and Swedish; however the geographical coverage within European countries is much wider than this would suggest.

As far as publishing on the Web is concerned, languages covered by the 'Latin-1' character set, are well supported in HTML. However, within Europe, Greek and Cyrillic alphabets are not adequately supported. There is also a particular problem with the International Phonetic Alphabet, which must be handled as graphic images.

Geographical Distribution. Telematic courses are predominantly although not exclusively based in the United States of America. A similar pattern is seen for course syllabus pages. This is undoubtedly due to the longer history of institutional networks in the U.S., and there are plenty of signs that equivalent components are being developed in Europe. HyperLink pages such as the World Lecture Hall based in Texas probably have a strong U.S. bias simply due to their own geographical position and use of English.

Other materials, tutorials, data and tools are well distributed within Europe. The bias to the U.K. as far as Educational Technology information is probably due to the bias in collection; it is likely that there are many equivalent materials in all Western-European countries.

Subject Areas. With respect to coverage of the different subject areas in the field of Speech Communication Sciences, there is a strong bias towards those areas where computers have been used for longest. There are a number of tutorial materials in acoustic-phonetics and practical phonetics, while fewer in (say) morphology or phonology. There are materials in computational linguistics, but little in syntactic theory. There is nothing yet in the inventory about Speech and Language Therapy, although there are many sites for the support of the communication disabled on the Internet.

5.2 Quality

We have not undertaken a detailed review of all the materials in the inventory, but even a cursory inspection reveals a wide range of quality. Some materials are clearly directed at learners, while most are 'reference' materials describing a particular theory or technique. Some materials are entirely introductory, requiring little previous knowledge, while others would only be useful if introduced by a tutor in the student's institution. Some are broad and shallow, others narrow and deep.

While in general this variety is to be applauded, it does raise problems for students. How can a student know which material is at an appropriate level? How can a student know whether it covers the topics he/she is required to learn? How can the student rely on the accuracy of the description?

Again, the design of material varies with regard to its mode of instruction: some are merely sequential descriptive, others follow principles of 'Open Learning' with objectives, self-assessments and summaries. How can the student choose the best for their own needs?

5.3 Tools

The potential author of Web-based instructional material has a mountain to climb to become familiar with the many technological components available on the Internet. While word-processing systems now make the generation of basic HTML pages straightforward, there are few simple tools to help novice authors with the interactivity and multimedia opportunities of the Web. Teaching systems need to offer materials with sounds, pictures and video; they should have an ability to ask questions and mark responses; they should be able to keep details on students' performance and status.

Current integrated tools for the building of instructional systems are rather limited. WebCT provides an infrastructure for a telematic course, but leaves the authoring of tutorial materials unsupported within the framework. As a consequence, the quality of the instruction the student receives - the heart of the educational experience - is dependent on the technological skill of the author. This tends to limit the most exciting materials to the most technological subjects, and makes it hard for authors in the Arts- or Clinical- based disciplines.

A separate issue is to do with software tools for teaching Speech Science. There is at least a 3-way split between users of Macintosh, PC/Windows and Unix computer systems among the institutions; each with different and incompatible program formats and audio support. The SFS software described above requires a single sound card type on PCs since it directly controls the hardware. Web formats for sound are multiple and can be of indifferent quality. While the use of authoring languages such as HyperCard or ToolBook can make materials easier to create, they can also add expense to the author and make the materials less portable to different computing platforms.

We have seen at least one use of the Java language and virtual machine in the inventory as a means to start to overcome some of these

inadequacies. Recommendations, integrated tools and example tutorial materials will also help in the future.

5.4 Data

Most of the references to Linguistic data in our inventory do not, surprisingly, lead to locations where data can be downloaded! Historically, speech data has been distributed on CD-ROM. Institutions such as the Linguistic Data Consortium in Pennsylvania, sell many types of data on CD-ROM and require users to sign restrictive usage licences. The new European Language Resources Association looks as though it will operate in a similar manner.

Thus although we might separate educational use from research use, and particularly educational volume (a few utterances) from research volume (hours of corpus recordings), there seems little opportunity for students and tutors to access a suitable variety of material in multiple languages, free of charge and free of usage restrictions.

The Linguistic Data Consortium [URL45], to their credit, do make available some of the TIMIT phonetic corpus accessible by anonymous FTP. However only a very poor quality version is accessible in this way.

5.5 Copyright

The issue of copyright also extends to educational material. Since the use of the Internet for education is still quite new, the financial people within institutions have not yet woken up the problem of the value of the educational materials made freely available on the network. While we don't seem to be under threat to charge for such information at present, it seems important that we should make a clear expression of ownership of intellectual property on all material made globally accessible on the network. We need to see authors protected from exploitation by commercial companies, while still allowing students free access.

6 Recommendations

6.1 Tutorials and Components

Our survey and inventory bear witness to the amount and range of educational material available over the internet, largely at zero or nominal cost. Ignoring the nature of the content for a moment, we can order this material, in a rather crude way, according to its size and degree of internal organisation. Tutorials and components represent

particular points on a scale which stretches from simple handouts at one extreme to complete programmes of study at the other as shown in Figure 5.16.

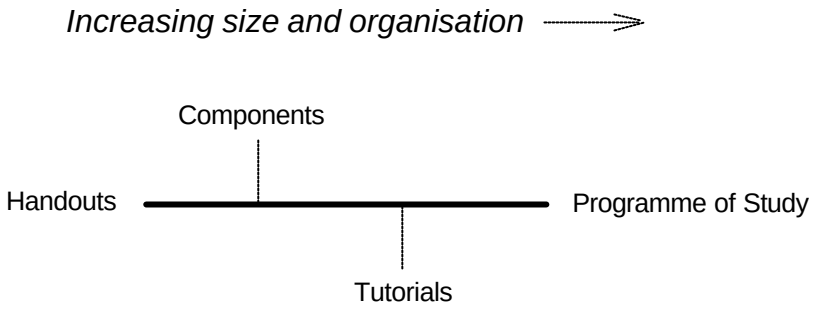

Figure 5.16: Size and complexity of educational resources.

Material tending towards the left end of the scale has progressively less content and internal structure. This has advantages and disadvantages. On the positive side is the supposed ease with which such material can be slotted into alternative contexts, thus allowing course authors to pick and choose as they please. For example, the categorical perception test in section 4.4 might serve in context A to illustrate what categorical perception is and in context B to actually create a set of categories. The disadvantage of small units is that the size of the educational experience they create tend to be correspondingly small. In order to create an educational experience of any substance, a large number of such units must be brought into play.

We choose our vocabulary carefully, since bringing into play is more than mere juxtaposition. Bringing into play has to maintain the coherence of a general point of view or line of argument and may involve more or less work depending on the extent to which the individual units share background assumptions.

Material at the other end of the scale has the opposite qualities: more and more in the way of content, internal structure and coherence, and less and less ability to slot into arbitrary contexts. A complete course provides the self-contained educational experience but you are more or less forced to take it or leave it as it is, since generally the cost of adaptation is higher than the cost of rewriting from scratch.

The question is whether there is a point on the scale which maximises the advantages and minimises the disadvantages. We believe that tutorials, being positioned somewhere around the middle of the scale, lie at just such a point.

6.2 Key Features Of Tutorials

A tutorial typically offers a structured learning experience of limited dimensions. In many ways a tutorial is just like a course with certain restrictions and general characteristics:

- ***Oriented to Self-Learning***: involves only the student and the material. Direct interaction with third parties is usually unnecessary to follow the tutorial successfully.

- ***Asynchronous***: interaction with the tutorial takes place intermittently; moreover, the student decides when interaction will take place, not the tutorial. Hence tutorials are also self paced.

- ***Restricted Topic and Prerequisites***: A tutorial concerns a clearly defined topic or group of related topics and has limited aims. The prerequisites associated with tutorials are usually minimal, but this should not exclude the idea of prerequisites altogether. What is important is that the tutorial author has a clear idea of what background the students are expected to have, and conversely that the student knows what background is expected.

- ***Restricted Conceptual Difficulty***: Essentially, a tutorial is not an advanced course. This could be manifested in many ways, e.g. though the use of explanatory material, the use of examples, the avoidance of presumptuous forms which assume a great deal of background knowledge. Of course, it is still possible to have tutorial level material in a difficult subject (this is precisely its raison d'être).

- ***Defined Internal Structure***: although some tutorials comprise a single chunk of text or hypertext (e.g. the Speech Analysis Tutorial [URL50]), the tutorial concept is big enough to accommodate more sophisticated kinds of structure (e.g. the "chapitres" of the Lausanne Phonetics course [URL51])).

- ***Completeness***: by and large, tutorials are self contained. However, being of a certain size, they are large enough to embody not just a piece of subject matter, but a ``perspective" that might extend through several tutorials. When this is the case, we can envisage larger units of study that are created by composing several tutorials together. A very good example of this is provided by the Java Tutorial [URL52] which is organised into "trails": groups of lessons on a particular subject which tell a different kind of story about the same topic.

- ***Self Assessment***: An important aspect of self-learning is self-assessment, the ability to judge one's mastery of the material being presented. Many tutorials make a point of providing for self-assessment in the form of exercises. The advent of languages like

Java and JavaScript considerably enhance the potential for interactive assessment exercises to take place over the internet.

6.3 Description and Indexing of Tutorials

One of the aims of the thematic network is to promote a common educational framework for the Speech Communication Sciences. The indexing of not just tutorials, but all types of educational materials, can only make sense in the context of such a framework. n integrated curriculum, which, from a functional perspective, can be usefully regarded as a kind of map with two projections, each of which serves a different purpose.

One of them, the "conceptual" projection, concerns the field of study, indicating how different parts of the subject as a whole relate to each other. The other projection (we could call this the "programme" projection), is essentially composed of pedagogical elements such as courses, tutorials, demonstrations: in short, items fitting on the scale shown in Figure 5.16. The projection gives information about the relations between these elements. Examples of such relations might be: item X is a prerequisite for item Y; item X can be used to assess performance of property P in item Y. From the information in this projection we can derive a set of possible programmes (only some of which will be realisable).

Many of the problems of indexing course materials will go away, or at least be alleviated, if a common framework exists. Procedures should therefore be instigated to make it exist sooner rather than later.

Whether or not the above scheme is adopted in the exact form just outlined, it is important to stress that in general, formal or semi-formal representations are less likely to be misunderstood than informal ones, and are therefore more likely to serve as the basis for a common language.

6.4 Providing Encouragement

Our survey has shown us a great deal of what is possible and what is the potential for computer-based methods. Future activities should be directed towards ensuring that potential is realised. This can be done in a number of ways:

- Help students and tutors find material. We should enhance our existing repository and make it more widely known.
- Design a set of tutorial ‘characteristics’ so that users can find tutorials of an appropriate content and depth.

- Encourage the creation of quality tutorials by publishing guidelines based on Open Learning principles (Race, 1994)
- Reward the authors of good tutorial materials with recommendations

Acknowledgements

We are grateful for the help of other members of the Working group and other members of the Thematic Network in the preparation of this Chapter. We thank all those that contributed information about educational resources through our questionnaire.

Uniform Resource Locators

1. http://www.york.ac.uk/inst/ctipsych/web/PsyCLE/PsyCLE.html
2. http://www.realaudio.com
3. http://www.icbl.hw.ac.uk/tltp
4. http://www.cti.ac.uk
5. http://www.icbl.hw.ac.uk/ltdi
6. http://www.icbl.hw.ac.uk/tltsn
7. http://www.icbl.hw.ac.uk/ltdi/man-info/umi.html
8. http://www.talisman.hw.ac.uk/
9. http://www.phon.ucl.ac.uk/home/netphon/Welcome.html
10. http://ukonln.bath.ac.uk/elib/
11. http://www.netskills.ac.uk/
12. http://weber.u.washington.edu/~dillon/adamn1.html
13. http://www.cse.ogi/CSLU/cse551/guessspec.html
14. http://svr-www.eng.cam.ac.uk/ajr/SpeechAnalysis/
15. http://www.research.att.com/
16. http://medicus.marshall.edu/medicus.htm
17. http://cvu.strath.ac.uk/admin/what-is-CVU.html
18. http://www.uhi.ac.uk/
19. http://tn-speech.essex.ac.uk/tn-speech/project/groups/tn-cal/quest.html
20. http://tn-speech.essex.ac.uk/tn-speech/project/groups/tn-cal/tn-cal.html
21. http://www.csuhayward.edu/ics/htmls/Inst.html
22. http://www.edb.utexas.edu/coe/depts/ci/it/projects/papers/special.html
23. http://homebrew.cs.ubc.ca/webct/
24. http://www.phonetik.uni-muenchen.de/AP/APHome.html
25. http://www.music.mcgill.ca/auditory/Auditory.html
26. http://ophale.icp.grenet.fr/
27. http://www.phonetik.uni-muenchen.de/Haskins/Haskins/MISC/PP/pp.html
28. http://www.phonetik.uni-muenchen.de/Haskins/Haskins/MISC/ASY/asy.html
29. http://www.ling.umu.se:80/~anderse/education/Katper.html
30. http://www.utexas.edu/world/lecture/linguistics/
31. http://www.bucknell.edu/departments/linguistics/ln105.html
32. http://www.cse.ogi.edu/CSLU/HLTsurvey/HLTsurvey.html
33. http://www.ilc.pi.cnr.it/EAGLES96/browse.html
34. http://ophale.icp.grenet.fr/esca/ProgAVSP.html
35. http://www.elsevier.nl:80/cas/tree/store/specom/free/noncas/audio/menu.sht
36. http://web-sls.essex.ac.uk/web-sls/
37. http://www.cse.ogi.edu/CSLU/fsj/home.html
38. http://www.uni-frankfurt.de/~ifb/bib_engl.html.
39. http://ophale.icp.grenet.fr/esca/labos.html
40. http://fonsg3.let.uva.nl/Other_pages.html
41. http://svr-www.eng.cam.ac.uk/comp.speech/SpeechLinks.html
42. http://mambo.ucsc.edu/
43. http://www.humnet.ucla.edu/humnet/linguistics/faciliti/software.htm
44. http://www.icp.grenet.fr/ELRA/home.html

45. http://www.ldc.upenn.edu/
46. http://ophale.icp.grenet.fr/ex.html
47. http://sunsite.doc.ic.ac.uk/Mirrors/simtel.coast.net/SimTel/win3/sound/
48. ftp://sunsite.doc.ic.ac.uk/computing.systems/ibmpc/windows95/
sound/gram32.zip
49. http://www.phon.ucl.ac.uk/resource/sfs.htm
50. http://www.ling.lu.se/research/speechtutorial/tutorial.html
51. http://www.unil.ch/ling/phonetique/api.html
52. http://java.sun.com:80/docs/books/tutorial/

Appendix I - CAL/Internet Resources Inventory

The working group has set up a Web-based database of teaching resources, to which individuals can contribute through a forms interface accessible by Web browser. Each night, the contents of the database are converted to HTML so that it may be viewed from anywhere on the Internet. The database currently contains details of over 80 resources, and in this chapter we have categorised the types of material it contains. We made the decision to focus on resources explicitly designed for educational purposes, and on materials that were accessible directly over the Internet. In future years we may widen our review to reference materials and to commercial materials. The following listing summarises the contents of the database.

1 General Information Category

Delivering Instruction on the World Wide Web

Paper on basic issues involved in Web based instruction, design and delivery.
URL:http://www.csuhayward.edu/ics/htmls/Inst.html

Using the WEB as an Instructional Tool

Overview of Web use for instruction in the University of Oregon. Discusses general issues about Web-based delivery.
URL:http://zebu.uoregon.edu/webreport.html

Special Considerations for Designing Internet Based Instruction

This paper addresses the questions: when is the Internet the appropriate technology for your instruction, and what do designers need to know to use it?
URL:http://www.edb.utexas.edu/coe/depts/ci/it/projects/papers/special.html

The Art of Developing On-line Courses

Guidelines for internet delivery based on sound instructional development principles. Contains links to other related material.
URL:http://www.cpcc.cc.nc.us/on_line/develop.htm

Teaching with the Web

Compilation of ideas for using WWW resources as a teaching **tool**.
URL:http://polyglot.lss.wisc.edu/lss/lang/teach.html

Interactive Courseware Tutorial

Over the past thirty years, computers have aided in the delivery and management of instructional material. The process has been evolving

with an emphasis on building a more effective, interactive instructional system. The early use of computers as an instructional delivery media was characterised by limited student control of instructional sequence and little interaction with the instructional content. Programmed text was presented to the student with prescribed drills/practice and pre-programmed answers and remedial comments. With technological advances the level of interaction and student control has increased. With advances in technology, the emphasis is on the development of intelligent instructional and tutorial models.
URL:http://ott.sc.ist.ucf.edu/1_2/index.htm

Learning Technology Dissemination Initiative

The Learning Technology Dissemination Initiative is a project funded by the Scottish Higher Education Funding Council to promote the use of learning technology and computer based learning materials.
URL:http://www.icbl.hw.ac.uk/ltdi/

Teaching and Learning Technology Programme

These pages provide information about the Teaching and Learning Technology Programme (TLTP) along with extracts from Newsletters and information releases. They act as a central access point for information servers run by other projects within TLTP and related areas.
URL:http://www.icbl.hw.ac.uk/tltp/

Web-Based Training Information Centre

The Web-Based Training Information Center is a non-profit resource for individuals and organisations interested in developing and delivering training using Web technology. The intent of this site is to share non-proprietary information, stimulate creative ideas, and link to interesting training sites around the world.
URL:http://www.clark.net/pub/nractive/wbt.html

CALISCENET

Caliscenet : a network of correspondents sharing interest in computer aided learning and instruction in science and engineering.
URL:http://diwww.epfl.ch/w3leao/calnet1.html

TONIC: Online Netskills Interactive Course

The course provides an introduction to the Internet and computer networks in general, describing and illustrating the main software tools for navigating the networks. The course looks at types and examples of networked information, at the means for searching that information, and at the communication facilities and resources on the net.
URL:http://www.netskills.ac.uk/TONIC/

Open University Institute of Educational Technology

The Institute is the largest centre for educational technology in the world and has top rankings for its contributions to teaching and for its research. In addition to its work on courses across the Open University, it is engaged in many collaborative projects and consultancies, in all parts of the world, as part of its mission and objectives.
URL:http://www-iet.open.ac.uk/iet/iet.html

WWW: Background Information

WWW: BACKGROUND INFORMATION The purpose of this document is to provide background information on WWW (World-Wide Web), HTTP (Hypertext Transfer Protocol), and HTML (Hypertext Mark-up Language). Information regarding NCSA Mosaic and other WWW browsers, plus material on other important aspects of cyberspace such as gopher and WAIS is covered.
URL:http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/Docs/www-info.html

2 General Tools

WebCT World Wide Web Course Tools

WebCT is a tool that facilitates the creation of sophisticated WWW based educational environments.
URL:http://homebrew.cs.ubc.ca/webct/

Multimedia Authoring Information

Covers: 1. Packages - sites with information on the main packages. 2. Prices - how much are these packages going to cost you? 3. Which authoring package? - an on-line argument on their faults and merits. 4. Which platform? - should you be developing multimedia on Mac or PC? 5. Discussion lists - further help available on designing multimedia.
URL:http://www.strath.ac.uk/CAL/author.html

Shockwave download Center / MACROMEDIA

Shockwave is interactive multimedia on the Web. It allows animated interfaces, interactive presentations, streaming CD-quality audio. Shockwave player delivers animation, audio, and multimedia. The streaming Shockwave player is available for free from Macromedia.
URL:http://www.macromedia.com/shockwave/

Authorware by MACROMEDIA

Authorware is an authoring environment for creating and publishing interactive information. Authorware provides tools to create networked interactive multimedia training and educational courseware.
URL:http://www.macromedia.com/software/authorware/

W3 Search Engines

This documents collects some of the most useful search engines available on the WWW.
URL:http://cuiwww.unige.ch/meta-index.html

3 Tutorials

Akustische Phonetik

Course material on acoustic phonetics
URL:http://www.phonetik.uni-muenchen.de/AP/APHome.html

En tur i fonetikens marker

This is a tutorial on linguistic and paralinguistic phenomena in speech. It touches the following topics: F0; formants; Swedish vowels; linguistic, expressive, organic, and transmittal factors shaping speech signals; the importance of F0 for the perception of these different kinds of qualities, especially in vowels; manipulations of paralinguistic quality; the modulation theory of speech; the role of expectations and perception by compatibility testing.
URL:http://www.ling.su.se/staff/hartmut/tur.htm

Web-based course in Corpus Linguistics

This is a free web-based course in Corpus Linguistics designed to provide a brief introduction to the area. It is based on a cut-down version of the book on Corpus Linguistics published by Edinburgh University Press. The course was developed as part of a collaborative venture between Lancaster University and Edinburgh University Press under the Innovation in Higher Education programme.
URL:http:/www.ling.lancs.ac.uk/monkey/ihe/linguistics/contents.htm

Phonetics and Phonology Tutorial

Covers: 1. Phonetics: Overview of Phonetics, Consonants, Vowels, Phonetic Examples, Phonetic Transcription/American English. 2. Phonology: Overview of Phonology, Phonological Rules, Phonological Rules Practice, Autosegmental Phonology.
URL:http://www.csulb.edu/~phoneme/pronunciation.html

Speech Analysis Tutorial

A brief introduction to waveforms, spectrograms and other speech analyses.
URL:http://www.ling.lu.se/research/speechtutorial/tutorial.html

A Course in Phonetics

These disks include nearly all the material in the tables and exercises in the textbook A Course in Phonetics. 16 DSDD disks, requiring about 25 meg of disk space when expanded.

URL:http://www.humnet.ucla.edu/humnet/linguistics/faciliti/software.htm

Acoustics Phonetics Teaching Materials / UCLA

This package includes two versions of the stack 'Acoustics for Phoneticians', one for students in which there is a lot of explanation on each card, and one for instructors to use in class, with fewer words in large type.

URL:http://www.humnet.ucla.edu/humnet/linguistics/faciliti/software.htm

Cours de phonétique de la section de linguistique de l'Université de Lausanne

Le but de ce document est de servir de support à l'apprentissage de la phonétique et à la maîtrise de l'Alphabet Phonétique International (A.P.I.). Vous pouvez parcourir cet (hyper)texte à votre guise, soit linéairement du premier chapitre au dernier, en sautant directement au chapitre qui vous intéresse grâce à la table des matière.

URL:http://www.unil.ch/ling/phonetique/api.html

On-line phonology course

The course is designed so that either native or non-native English speakers can achieve quite a sophisticated understanding of the basics of phonology. It is designed as a teaching aid rather than as a definitive study of phonology and, as such, sacrifices detail in favour of clarity and ease of understanding.

URL:http://www.stir.ac.uk/epd/celt/staff/higdox/stephen/phono/phonolg.htm

Einführung in die Sprachsynthese

Introductory text on speech synthesis with a link to the Haskins Pattern playback page.

URL:http://www.phonetik.uni-muenchen.de/HS/Synthese.html

CSLU Spectrogram Reading Home Page

Covers: Why would anyone want to read a spectrogram? What are waveforms? What are spectrograms? What are phonemes? Improve your spectrogram reading skills. Spectral cues for English phonemes. View spectrograms for common words. Call the CSLU and see your own voice. The current mystery spectrogram.

URL:http://www.cse.ogi.edu/CSLU/cse551/

Das Lesen von Sonagrammen V0.2

Course material on spectrogram reading

URL:http://www.phonetik.uni-muenchen.de/SGL/SGLHome.html

Automatische Spracherkennung - Grundlagen, statistische Modelle und effiziente Algorithmenn

Lecture notes for a course on speech understandíng based on the book "Automatische Spracherkennung - Grundlagen, statistische Modelle und effiziente Algorithmen" by Ernst Günter Schukat-Talamazzini.
URL:http://www5.informatik.uni-erlangen.de/HTML/English/Lectures/sprachverst/sprachverst.html

Language and Brain / Sprache und Gehirn

An audio-visual tutorial on clinical linguistics and phonetics. Contents: Introduction to the motor system and neuro imaging, description of language and speech pathologies, language and speech diagnostics, glossary and extensive bibliography. The tutorial is mostly in German.
URL:http://www.ims.uni-stuttgart.de/phonetik/joerg/sgtutorial/

4 Component Resources

Categorical Perception

A perception test, replicating a classical experiment on Categorical Perception.
URL:http://www.ling.umu.se:80/~anderse/education/Katper.html

F0 and vowel perception

This is a demonstration of the importance of the frequency of the voice fundamental for the perception of the linguistic, expressive, and organic qualities of vowels. It is shown that not only the organic and expressive qualities of a vowel, but also its linguistic quality varies widely with F0.
URL:http://www.ling.su.se/staff/hartmut/i.htm

Equations for CB-rate, CB, and ERB

The most accurate equations for Hz to bark conversion and inverse presented together with some reasoning about when it is correct to use CB-rate and ERB.
URL:http://www.ling.su.se/staff/hartmut/bark.htm

3D modelling of visible speech gestures

Presentation of several 3D models of facial components controlled by speech-oriented command parameters.
URL:http://ophale.icp.grenet.fr/2.6.html

Description of ToBI Prosodic Labelling System

ToBI (for Tones and Break Indices) is a system for transcribing the intonation patterns and other aspects of the prosody of English utterances.
URL:http://ling.ohio-state.edu/Phonetics/E_ToBI/etobi_homepage.html

The Pattern Playback

A description (w. sound clips in .au and -aiff) of the Pattern Playback `talking machine', an early speech synthesiser constructed in the late 1940s.
URL:http://www.phonetik.uni-muenchen.de/Haskins/Haskins/MISC/PP/pp.html

UCSC Perceptual Science Laboratory

Information is available on the following topics: Facial Animation, Facial Analysis, Speechreading (Lipreading).
URL:http://mambo.ucsc.edu/

Click and Listen

"Click and Listen" is a network-based teaching resource for phonetics and phonology, with particular emphasis on the sounds of Scots and Scottish English. The WWW site contains examples of the type of material being developed.
URL:http://wheecher.arts.ed.ac.uk/

5 Course Information

Linguistics 105 Sounds and Words

This is an on-line interactive syllabus for a course in linguistic phonetics.
URL:http://www.bucknell.edu/departments/linguistics/ln105.html

World Lecture Hall/Linguistics

Hyperlinks to syllabus information and telematic courses in Linguistics, Phonetics and Spoken Language Processing.
URL:http://www.utexas.edu/world/lecture/linguistics/

Ling 253: Laboratory Phonetics

Interactive Course Syllabus: Information, Lecture Notes, Resources, Speech Files, Laboratory
URL:http://gopher.udel.edu/idsardi/253.htm

Acoustic Phonetics Slides

Slide show of a course in Acoustic Phonetics
URL:http://eras-speech.essex.ac.uk/eras-speech/syllabus/acoustic.html

Language, Mind and Society Course

Syllabus and Course Notes, with Articulatory Phonetics tutorial.
URL:http://macweb.acs.usm.maine.edu/usm_linguistics/Course%20Materials/185Language%2cMindandSociety/LIN185_F96/185_F96.html

6 Bibliographies and Refereed Articles

Online Bibliography: Phonetics and Speech Technology

Search for books and articles on subjects allied to Phonetics and Speech Technology in this bibliography with over 10,000 entries.
URL:http://www.uni-frankfurt.de/~ifb/bib_engl.html

Content of the Speech Communication Journal

Gives a list of the articles published in the "Speech Communication" Journal since 1994.
URL:http://www.elsevier.nl/eee/specom/contents.html

WEB-SLS The European Student Journal of Language and Speech

Web SLS is a joint initiative of ESCA, EACL & ELSNET Given the wide coverage of the Journal in terms of scientific areas, nine very broad classes on which to concentrate have been selected: SRS - speech recognition and synthesis NLUG - natural language understanding and generation LI - language identification IER - information extraction and retrieval DMC - dialogue modelling and control MLPP - models of language perception and production SM - stochastic modelling GCLD - grammars, corpora, lexicons and databases SAS - system assessment strategies
URL:http://web-sls.essex.ac.uk/web-sls/

The Free Speech Journal

The World Wide Web provides an excellent opportunity to fix a serious problem in science -- the long delay in publishing research results in scientific journals. Typically, more than a year goes by, often two, between the time a manuscript is submitted for publication and the time it appears in print. The Web provides an efficient means of communicating research advances and new ideas, and an opportunity to reduce publication delay by an order of magnitude. The motivation for founding the Free Speech Journal (FSJ) is to improve communication among scientists in the area of human language technology. This is done by providing a peer review journal (FSJ) for publishing research results of the highest quality in the shortest possible amount of time.
URL:http://www.cse.ogi.edu/CSLU/fsj/home.html

Computation & language EPrint Archive

Archive of academic papers from researchers in NLP, NLE and computational linguistics.
URL:http://xxx.lanl.gov:80/cmp-lg/

7 Links pages and non-refereed articles

Speech Technology Hyperlinks

Probably the biggest list of speech technology links available. From the comp.speech newsgroup Frequently Asked Questions list.
URL:http://svr-www.eng.cam.ac.uk/comp.speech/SpeechLinks.html

Linguistics & Phonetics Worldwide

Extensive structured list of language and speech related hyperlinks.
URL:http://www.ims.uni-stuttgart.de/phonetik/joerg/worldwide/lingphon.html

List of European & worldwide Speech Laboratories

List of home pages referring to Research Laboratories in Phonetics & Speech Communication. This list is produced by ESCA, the European Speech Communication Association.
URL:http://ophale.icp.grenet.fr/esca/labos.html

Speech on the Web

Links to many pages that are related to phonetics and speech sciences: Meetings, Lists, Phonetics, Language Processing, Computational Linguistics, Dictionaries, Newsletters
URL:http://fonsg3.let.uva.nl/Other_pages.html

The Human Languages Page

Information about the languages of the world. Language resources, dictionaries, tutorials, samples.
URL:http://www.dcs.warwick.ac.uk/~bear/Language-Page.html

Ethnolinguistics and Phonetics on the Internet

An ordered list (on keyword and title) of Internet sources with United Resource Locator, summary and additional comments.
URL:http://grid.let.rug.nl/~degraaf/EthnoPhon/linklist.html

Links to Hypermedia demonstrations and collections

Links to Hypermedia demonstrations and collections: Speech Synthesis, Speech Recognition, and others
URL:http://fonsg3.let.uva.nl/IFA-Features.html

European Language Resources Association

ELRA is a non-profit association who disseminates speech & language resources
URL:http://www.icp.grenet.fr/ELRA/home.html

The International Phonetic Association

Activities of the International Phonetic Association
URL:http://www.arts.gla.ac.uk/IPA/ipa.html

Computer Assisted Pronunciation Investigation Teaching and Learning SIG

CAPITAL is a group of researchers and practitioners interested in using computers in the domain of pronunciation.
URL:http://showme.missouri.edu/~langdans/capital.html

Resources for Studying Human Speech

The Internet is rich in resources for the study of speech sounds. Here are some that I have collected and used. You should be able to use some of them at least online if your system supports the replay of AU or WAV sound files.
URL:http://weber.u.washington.edu/~dillon/PhonResources.html

8 Speech Science Data

British National Corpus of English

The British National Corpus is a very large (over 100 million words) corpus of modern English, both written and spoken.
URL:http://info.ox.ac.uk/bnc/

MARSEC: Machine Readable Spoken English Corpus

MARSEC is a CD-ROM of the recordings transcribed in the Spoken English Corpus (SEC). Annotations at word, grammatical and prosodic levels are available.
URL:http://midwich.reading.ac.uk/research/speechlab/marsec/marsec.html

Oxford Acoustic Phonetic Database

Available on compact disc, from J. Pickering and B. Rosner. It contains data on vowel-consonant and consonant-vowel combinations in both stressed and unstressed locations. The language covered include French, German, Hungarian, Italian, Japanese, British English, Spanish and English.
URL:http://svr-www.eng.cam.ac.uk/comp.speech/Section1/Data/oxford.html

The Sounds of the World's Languages

15 DSDD disks, requiring about 35 meg of disk space when expanded Sounds of the World's Languages (SOWL) is a Hypercard tool and database developed at the UCLA Phonetics Laboratory to illustrate and teach about the range of sounds used in human languages with material on more than 80 languages.
URL:http://www.humnet.ucla.edu/humnet/linguistics/faciliti/software.htm

UPSID and PHONEME

The UCLA Phonological Segment Inventory Database of (currently) 451 languages, with programs to manipulate and modify it.
URL:http://www.humnet.ucla.edu/humnet/linguistics/faciliti/software.htm

Relator project speech corpora index

This is an index page describing a large number of speech databases through Europe.
URL:http://www.icp.grenet.fr/Relator/countries.html

EUR-ACCOR acoustic and articulatory database

ACCOR is a unique acoustic and articulatory database recorded as part of the ESPRIT- ACCOR project investigating cross-language acoustic-articulatory correlations in coarticulatory processes. European Languages include: Catalan, English, French, German, Irish Gaelic, Italian and Swedish.
URL:http://www.icp.grenet.fr/Relator/multiling/euraccor.html

Audio files associated with articles in the Speech Communication Journal

Audio files associated with articles published in the journal "Speech Communication"
URL:http://www.elsevier.nl:80/cas/tree/store/specom/free/noncas/audio/menu.sht

Linguistic Data Consortium Speech Corpora

The Linguistic Data Consortium is an open consortium of universities, companies and government research laboratories. It creates, collects and distributes speech and text databases, lexicons, and other resources for research and development purposes. The LDC is currently collecting thousands of recorded telephone conversations among speakers of more than ten different major languages of the world. Calls are initiated from the United States or Canada and made to all parts of the globe.
URL:http://www.ldc.upenn.edu/

Speechlab / Sprachlabor

Speechlab is a multimedia tutorial on phonetics, containing chapters on articulation, acoustics, speech analysis, and a multimedia reference of American and German speech sounds (video, audio, articulatory and acoustic description). Also included are a small speech analysis tool and a bibliographic database containing over 4000 articles. Sprachlabor is the German Version, without the American sound lexicon.
URL:http://www.media-enterprise.de

WordNet a lexical database for English

On-line and downloadable version of a large lexicon.
URL:http://www.cogsci.princeton.edu/~wn/

9 Speech Science Tools

Speech Filing System

The Speech Filing System (SFS) is a large collection of inter-working tools for speech analysis, processing and display. It used both for research and in our teaching laboratory at University College London.
URL:http://www.phon.ucl.ac.uk/resource/sfs.htm

Czech TTS System for Windows

Czech Text-To-Speech system for Windows. As user application can read files, selected text in any application (via clipboard) and as MCI driver. Application interface: DDE communication. Text to Speech Engine (W95,NT only) form in progress.
URL:http://www.anet.cz/frog

WinSAL and WinSAL-V

WinSAL is a speech analysis system for Windows 95. It allows to load, segment and display multiple audio files in the wav format. Functions include oscillogram, spectrogram, Energy, Pitch, FFT, LPC, Cepstrum, Autocorrelation, AMDF. Data can be saved to text files, screen hardcopies are possible. WinSAL-V additionally allows to analyze video files in the AVI format.
URL:http://www.media-enterprise.de

Natural language software registry

Software for speech signal analysis, syntactic analysis, formalisms, generation, knowledge representation, applications.
URL:http://cl-www.dfki.uni-sb.de/cl/registry/draft.html

Intelligent Speech Analyser

The intelligent speech analyser is a software tool running on Macintosh computers. It allows a large number of types of display of speech signals including waveform, FFT, cepstrum, LPC, Auditory spectrum, long-term average spectrum, F0, Jitter, Shimmer, etc. It is unclear as to the cost from the home page.
URL:http://www.sci.fi/~pitchsys

SAM Speech Tools

This is a list of speech tools produced during the ESPRIT 2589 "SAM" Project. It consists mainly of software tools running on a standard SESAM workstation (PC-DOS based) Labelling, Data collection, Signal editing, Processing, DBMS, Testing - Scoring , Recognition.
URL:http://www.icp.grenet.fr/Relator/tools/spbacktools.html

SIL Software for Linguistics

Summer Institute Of Linguistics: Computing Resources, including: publications, bibliographies, research projects, training, tools, fonts.
URL:http://www.sil.org/computing/sil_computing.html

Lucent Technologies Bell Labs Text-to-Speech system

The site has interactive demos in American English, Mandarin Chinese, and German, and the capability to adjust voice parameters on the fly (English only). Pre-synthesized demos for Mandarin Chinese, French, Italian, Russian, Spanish, and Romanian are also provided.
URL:http://www.bell-labs.com/project/tts/

Articulograph AG100 Demo - Programs for downloading

Emalyse : Visualisation - Analysis - Segmentation Tailor : Editing - Post-processing - Normalisation MultiCV: Format conversion - data export. The Emalyse is well equipped with features to show all information from the recorded data. It makes it easy and secure to places markers and segments with high precision at the desired positions. The modifications on the data are only done by the Tailor program. It does the general data post-processing and is also able to read the Emalyse marker- and segment information to do the required data manipulation. The MultiCV changes the format from the data but does not change the data itself. It makes the data readable for general data base and calculation programs as well as graphic presentation programs.
URL:http://www.articulograph.de/demo_p.htm

IPKoeln: Speech synthesis

An articulatory speech synthesizer has been developed at our phonetics department. The input of the program is a phonetic symbol string and its output is an acoustic speech signal. The program can be divided into three subsystems. The first subsystem calculates a movement pattern for the model articulators (lips, tongue, velum, glottis) on the basis of the symbol string (broad phonetic transcription). For this calculation a segmental or a gestural production model can be used. The second subsystem is the articulator model. It calculates the geometry of the vocal tract (the area function) for each time instant. The third subsystem is the aerodynamic-acoustic model. It calculates the acoustic speech signal.
URL:http://www.rrz.uni-koeln.de/phil-fak/phonetik/synthese/index_e.html

COMPOST

COMPOST is a complete environment for text-to-speech developers. It offers: - A rule-compiler where declarative (grammars) and procedural (external calls to C code) knowledge can be combined. The standard library offers a Morphological Analysis, a N-class Syntactic filter, a TD-PSOLA synthesizer... - COMPOST is built as a client-server model: a

compiled scenario for any language may be loaded by the server and used by clients to convert text into speech - Scenarios have been developed for French, Catalan and Castillan
URL:http://www.icp.grenet.fr/cgi-bin/synthese

Text-to-audiovisual-speech

Presentation of a text-to-audiovisual-speech synthesizer whose front-end is a parametric model of the face.
URL:http://ophale.icp.grenet.fr/2.1.html