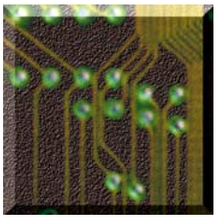

Fostering Successful APL Technical Communications

William T. Pullin, Jr., Angelika D. Peck, David W. Sussman, and *Margaret K. Morris*

APL offers a creative environment in which scientific, engineering, and technological ideas come to light, take shape, and mature. Communicating those ideas to the defense, scientific, and academic communities often fosters more ideas. The Laboratory's central resource for technical communications helps APL staff present their ideas through services including publications, presentations, traditional and multimedia exhibits, graphic art and design, photography, Web development, video, television production, 3D animation and multimedia, and printing. (Keywords: Communications, Multimedia, Proposal production, Publishing, Technical illustrations.)

INTRODUCTION

APL staff must communicate the work of the Laboratory to sponsors and to the defense, scientific, and academic communities. Up through the 1980s, this generally was achieved by publishing technical reports for sponsors and articles for professional, refereed journals. This practice has enhanced APL's reputation as a high-quality technical organization and a leader in the scientific community. Other media such as viewgraphs, posters, and exhibits used at professional society conferences were also effective vehicles for disseminating information. Although film documentaries (and later videos) for sponsors were less common because of the high cost, they were used if color, motion, and time-lapse effects were required to effectively convey a technical message. Until fairly recently, color was rarely used, again because of cost; black-and-white publications and presentations were generally adequate for the communications needs of scientists and engineers in research and development laboratories like APL.

Over the last decade, however, the environment has changed. With the end of the Cold War and aggressive cuts in DoD funding in favor of civilian programs, APL recognized the need to more effectively dispense information to current and new sponsors and to expand communication efforts to other audiences (including civilian agencies). Broad new communications initiatives focused on how APL might provide innovative solutions to new sponsors. As these new business development initiatives got under way, sharing the work of APL with those who had little or no familiarity with the Laboratory became a challenge.

At the same time, the publishing industry was undergoing a technological revolution of greater significance than anything since the invention of the printing press. The possibilities for getting a message across changed and expanded. No longer was a black-and-white, low-tech presentation or paper adequate for communicating state-of-the-art results or winning new sponsors. Over this period, APL's central resource

for technical communications within the Technical Services Department (TSD), the Technical Communications Group (TST), has kept abreast of technological changes in communications and publications and has continued to expand the options available to APL staff.

Today, when a scientist or engineer considers how best to convey ideas, the possibilities are much wider:

- Traditional black-and-white printing, low-cost color copying, and two- or four-color printing
- Sophisticated graphic design to help target particular audiences
- Writing or editing to focus the message for print or electronic publication
- Color presentation viewgraphs and laptop computer presentations
- Teleconferencing
- Web and Internet publication
- Exhibits with multimedia kiosks
- Photo-realistic digital artists' concepts, modeling, and 3D animation
- Digital photography/video/TV production

These are just a few examples. Using the various options effectively projects a strong, positive image for APL. Of course, defining the message has always been paramount to establishing effective communication; no less important is that the ideas be understood and accepted. With the explosion in publishing technology, other variables have entered the mix. The culture at large has become visually oriented as never before; readers expect high-quality communication, good design, appropriate and realistic illustration, and good writing, whether on paper or in the script of a video. Which technology is right for communicating a particular message? What is the best means to capture a particular audience and convey the appropriate content? How can available resources be used to maximum effect? The options are plentiful, and yet the need for time-efficient, cost-effective, and powerful communication has never been greater.

The focus of TSD's Technical Communications Group is to help APL engineers and scientists select appropriate media and use them cost-effectively and well. TST's many experts in communication and printing technologies consult with APL staff, helping them to focus their message, select the options that best represent APL's technical expertise, and attract potential sponsors.

In this article, we give some examples of how TSD's communications professionals work with APL staff members to enhance communication, staying at the forefront of communications technology in the process. Information reuse is facilitated by applying the appropriate tools and systematically archiving material. Training, upgrades, and process refinements are routine events, resulting in frequent productivity improvements that enhance quality, reduce cost, improve timeliness, and prepare us for the future. Periodic benchmarking helps us to stay on track. TST staff have won a number of prestigious awards for excellence in communication. These awards attest to the outstanding support available to APL staff in getting their message out to sponsors, colleagues, and the public.

ENHANCING THE EFFECTIVENESS OF COMMUNICATION

Technical Illustration

Technical artists, illustrators, and photographers have historically helped APL staff share their ideas with potential sponsors. The role of the technical illustrator has become increasingly important in communicating complex concepts that are difficult to visualize or grasp. TST-created digital illustrations are flexible; they can be modified and reused in many forms, following an idea from rough concept through marketing, final design, and production, even to incorporation into educational and public information campaigns. Archiving, reuse, and revision help keep costs within budget. Visual scientific communication is increasingly important in today's visually oriented culture.

APL staff often seek assistance from TSD's central communications resource in presenting ideas visually. They sometimes have sketches for the artist to work from, sometimes only ideas. For example, in early 1992, a scientist from the Space Department had the concept for a gravity gradiometer in mind. He described it to the technical illustrator, who made a rough sketch (Fig. 1a) and then created a digital illustration (Fig. 1b). Where time and cost would have prohibited this in the past, a concept could be presented in realistic detail. That primitive illustration represented an astonishing improvement in conceptual illustration. By 1994, the same scientist had more complex requirements,[1] and so the technical illustrator added detail and depth (Fig. 1c). Since this initial experience, such collaborations have become routine. Technical illustrators confer with customers, listen to their ideas, and visually represent increasingly complex concepts (e.g., Fig. 2). Such "artists' concepts" are now a common, cost-effective, and fruitful communication tool.

During the life of a project, an illustration may be modified numerous times to reflect changes in design or audience, or it may be produced for many different venues. Skillful use of illustration software and rigorous archiving procedures make such reuse possible. For instance, some of the illustrations created for MESSENGER (a mission to Mercury recently selected in the NASA Discovery Program) have been used repeatedly in the written and oral proposals, on posters

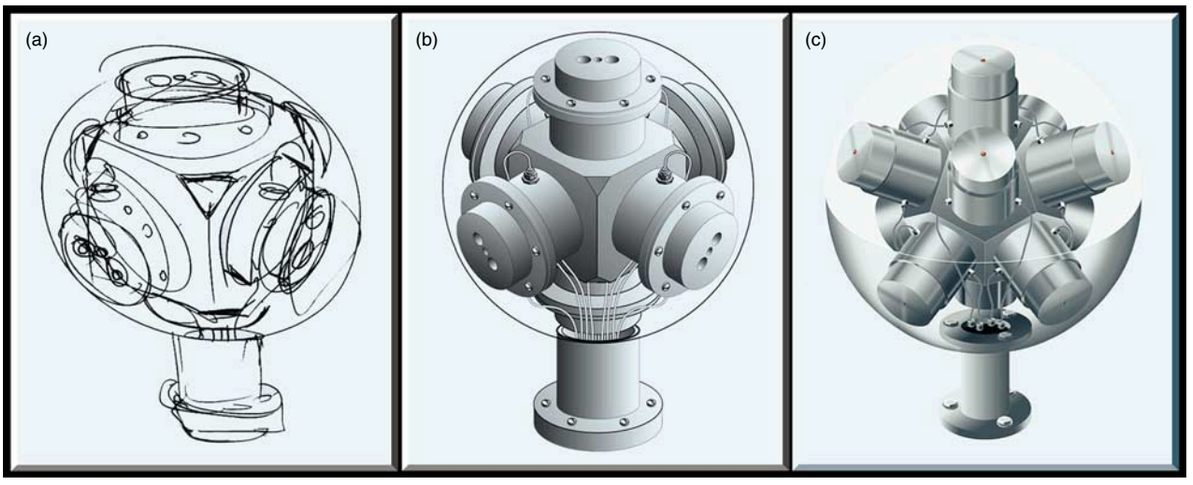

Figure 1. Evolution of the artist's concept for the gravity gradiometer. (a) Artist's rough pencil sketch; (b) first computer drawing, made with "primitive" illustration software; (c) published illustration, incorporating numerous design changes made to the original concept.[1]

for exhibits, in papers and viewgraphs for scientific meetings, on Web pages, and in videos. Some will even be silk-screened onto coffee mugs and T-shirts as part of a project's public outreach campaign.

Effective technical communication is the focus. The technical expertise of TSD's communications professionals allows cost-effective[2] modification and reuse of scientific and technical illustration through

- Visualizing complex ideas
- Controlling, modifying, and reusing large, complex files
- Managing the challenges of color in different types of output
- Appropriate use of archiving and digital printing technology

Photography

In proposing new concepts, APL staff have always used photographs. Sometimes, however, the photographs may not convey the precise message required. High-resolution digital cameras are now being employed in addition to traditional film cameras to capture photographic images in digital form for immediate use, thereby eliminating the process of printing and then scanning film slides and photographs. With a high-resolution digital camera, the TST photographer and APL staff member can review digital previews during the photo shoot to ensure that the image is appropriate. The photograph can then be downloaded to a computer and used immediately. If a photograph still requires further modification, or if the precise message cannot

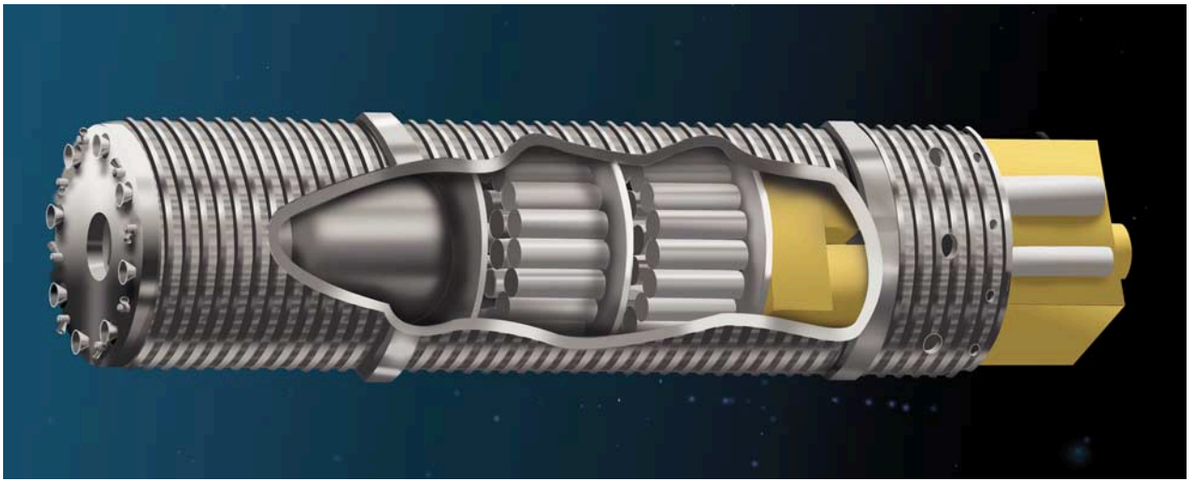

Figure 2. Artists now routinely create realistic, highly detailed illustrations such as this concept for a servicing spacecraft.

be shown in the available space, the artist can manipulate the digital image to produce a new photographic-quality image with the proper elements.

Figure 3 shows how this manipulation worked for an APL staff member who wanted to convey an idea in a fact sheet for a transportation project. He had only two photographs (Fig. 3, top left and center). After examining them, the staff member and the communications team determined that the optimal image to depict the message ought to show a truck, a weigh station, a computer display, and an inspector. The two photos were digitized using a scanner. By digitally selecting and combining the essential elements of each scanned image and then completing the truck and cloud pattern, the team digitally created a photo (Fig. 3, top right) that appears realistic and illustrates the intended message.

Written and Oral Technical Proposals

A proposal team must design a solution that meets the needs of a potential customer (sponsor). In addition to designing an excellent solution, however, the team must sell the solution with a document, briefing, or both. If the customer is the government, the document is produced according to arbitrary rules about content, organization, length, type size, etc. For an oral briefing, visuals and exhibits must get the appropriate information across, be well designed, and invite attention. (If the customer does not look at or cannot read the presentation materials, it doesn't matter what they contain.) Beyond that, slides, viewgraphs, and exhibits convey a subtle but real message about the professionalism and competence of the organization.

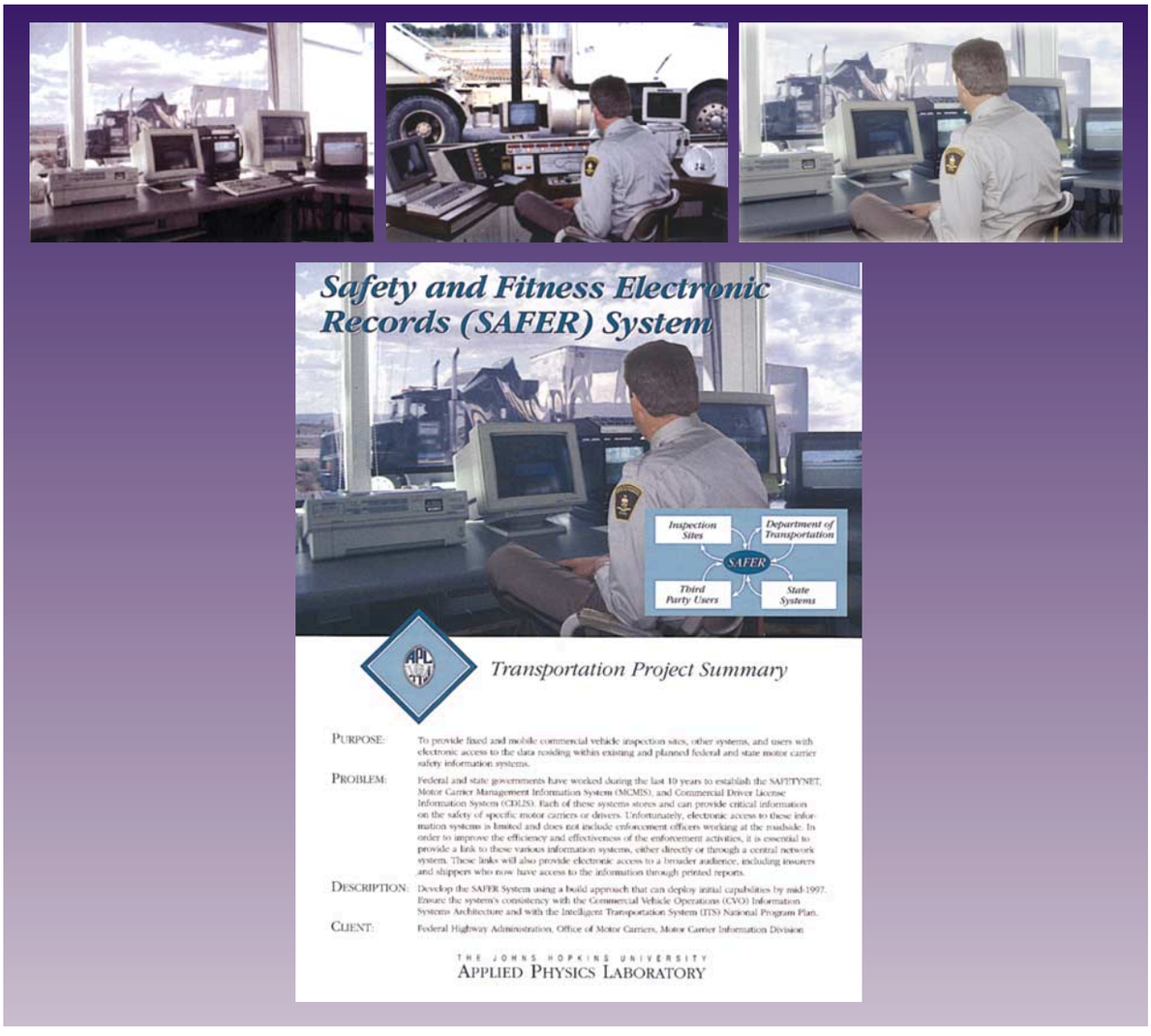

Figure 3. Digital manipulation helps photographs tell the right story. Two photographs (top left and center) were combined and manipulated digitally to make a single image (top right) that illustrates the intended message.

The skills needed to design a winning technical solution and those needed to write, design, and produce a proposal document or briefing are different. TSD's communications professionals frequently help APL staff produce proposals, both large and small. The TST editor/production manager can help the proposal manager plan, organize, schedule, and produce the document or briefing materials, serving as the conduit for needed editorial, artistic, page layout, and printing support. The process varies greatly depending on the proposal team's needs. The result is a visually attractive, easy-to-review document that meets requirements and reflects the technical excellence of the proposed solution. Reviewers are not distracted by document-related issues, and they can quickly find everything they need to score the submission.

As in other areas, TST uses benchmarking, monitors processes and productivity, and works continually to keep support for proposals cost-effective and up to date. The proposal process in use is similar to that recommended by well-respected consultants in the field (e.g., see Safford[3]). After major proposal efforts, "lessons learned" sessions are held and processes are updated if appropriate. TST recently instituted a detailed proposal intake questionnaire to clarify requirements at the start of a proposal. It has improved planning and communication within publications teams during proposal production.

Production costs are carefully monitored as well. Proposal support costs are highly dependent on the nature of the proposal and the type of support requested; they are less dependent on proposal length (Fig. 4a). However, the technical communications team's efforts to continually improve the process and reduce costs have paid off. Productivity has steadily increased, and a linear regression of data shows a steady decrease in proposal support costs since 1995 (Fig. 4b).

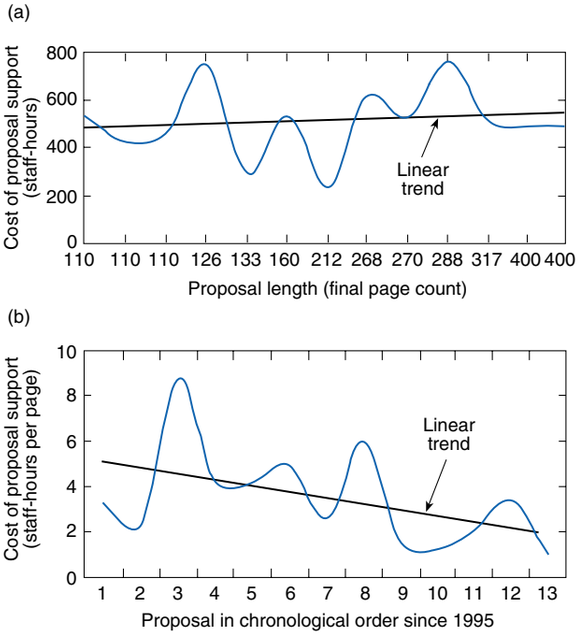

Figure 4. TSD proposal support is highly variable, depending more on the type of support than the length of the proposal (a). Steady improvements in process and productivity have resulted in a gradual decline in proposal costs since 1995 (b).

The *Johns Hopkins APL Technical Digest*

One way that TSD's communications professionals maintain their cutting-edge skills in the rapidly changing fields of publishing[4] and printing technology is through the *Technical Digest*. As a reader of the *Digest*, you know that it is a quarterly in-house journal highlighting the work of the Laboratory. Each issue generally focuses on a theme (a department or particular sponsored work). The *Digest* has served its readers in the scientific and engineering communities for the past 20 years. Over the last decade, many changes have been adopted to maintain reader interest and to keep the style current. In 1993, the newly appointed Editor-in-Chief, Dr. Kishin Moorjani, initiated his challenge to publish and distribute the *Digest* before that issue's masthead date and to establish it as a journal that staff members were proud to have represent their technical contributions. Both goals have been achieved. Each issue is published on schedule or before, and there is a 2-year waiting line for upcoming theme issues.

TST has facilitated Dr. Moorjani's schedule objectives by improving the publishing production process. As new technologies become available, they are researched, tested, and applied before becoming part of the everyday production process. This ensures that the *Digest* team maintains its state-of-the-art publishing expertise.

The *Digest* appears in two formats: (1) a hard copy edition printed on a high-resolution press, and (2) a searchable online version published on the APL external Web site. Three major new technologies are used to publish both versions efficiently and at reduced cost: PDF (a cross-platform format), color management technology, and digital photography. The systematic application of cutting-edge digital technology and improved electronic techniques has made productivity and quality improvement a continuing process. A chronology of some milestones of the last decade is given in Table 1.

The use of new PDF technology to run high-resolution printing presses required the communications team and the printer to work together to test and push the technology envelope of both the electronic input files and the press. Previous electronic publishing methods and workflow (including font usage, file linking, and onscreen proofing) needed upgrading. The team rethought and revised the procedures for creating the PDF files. Postscript files were first made using the

Table 1. Major steps taken to continually improve the quality of the *Digest*.

Year	Volume (issue)	Significant advance
1992	13(3)	First use of digital black-and-white drawings (replacing the practice of cutting and stripping art into the negatives)
1992	13(4)	First use of digitally manipulated color photographs integrated in text pages
1993	14(1)	First in-house production of entirely integrated digital four-color film negatives, quality checked and delivered to printer
1994	15(1)	First use of a four-color digital proofing system; first "wrap-around" cover
1995	16(1)	First appearance of completely redesigned and updated format
1995	16(4)	*Digest* goes online soon after Acrobat PDF is introduced as a method of placing articles on the Web
1998	19(3)	Disk with digitally integrated pages supplied to printer for one-piece film output
1999	20(2)	Disk with high-resolution digital pages supplied to printer as PDF files shortly after print shops began to use PDF as input to the software controlling the printing presses (a single, relatively small PDF file contains an entire article with all linked files and embedded text fonts; the file cannot be accidentally altered)
1999	20(4)	First use of high-resolution digital cameras to photograph authors and APL projects; images are captured for immediate use, eliminating the process of scanning film slides and photographs

traditional cyan, magenta, yellow, and black (CMYK) four-color printing method; the files were then distilled using Adobe Acrobat Distiller. The team tested the files with the printer, who used Scitex software to raster-image-process them directly for input to the presses.

A current effort involves advanced color management technology. In preparing *Digest* material, the colors on a computer screen look different from those on the printed pages and electronic displays because of the various imaging technologies employed. The objective is to manage the colors on all devices, including the printing press. This has been achieved by creating a custom International Color Consortium (ICC) profile, a fingerprint of the device's color capabilities. Using an X-rite colorimeter, all workstation display monitors are profiled and calibrated. By using a calibrated monitor and the profiles together, image colors can be proofed directly on screen. This approach will eventually eliminate color variations among the different devices. Once in place, such color management will give predictable color regardless of the output device.

APL staff members often ask for rework to compensate for color shifting when printout color does not match the screen, or when the final printed version does not match the proof. Having recently solved this problem for the *Digest*, we are propagating the solution throughout the rest of the devices used by TST (monitors, proof printers, and presses). Successful color management will eliminate the rework (and its cost) caused by color shifting.

Multimedia

Video, Television, Teleconferencing, and Animation

Audiovisual, television, photographic, and video teleconferencing services continue to evolve as communications technologies and techniques change at an ever-increasing pace. As these services move from traditional methods to digital processes, the essential qualities of good communication are still major drivers. Presentations must still communicate ideas in both the written and visual domains. High-quality image capture, whether motion or still, will always rely on good composition, lighting, and perspective. Professional television productions may be delivered via the Internet, DVD, or traditional videotape, but the delivery medium is not the message, the message *content* is the key element.

Communications that are written and produced well explain complex concepts on multiple levels to as many different viewers as possible. Some ideas require only simple techniques to impact a large segment of recipients; others may require a 3D animated virtual world for the viewer to "fly through." Emphasis on "slick" communications or "flavor-of-the-month" technology does not serve the needs of APL staff, and in many cases it can obscure a message. Our effective communications teams put the idea first and then seek the best blend of technology to communicate that idea to the intended audience.

In a very short time, visual media technologies from illustration to video content have moved from the analog world to the digital computer platform. Computers have increased the artist's productivity, opened

new options for visual communication, and created new methods for marketing. With these advanced skills, illustrators are able to add their technological expertise to their artistic technique. Today's computer media artist is skilled in broadcast-quality video editing, Web page layout, interactive media, and 3D animation and rendering. The new vision and goal of this digital maestro is to empower the viewer to access, interact with, and understand the presentation.

Today, APL's central communications resource offers interactive presentations, kiosks, Web products, and CD-ROMs (for both educational and business-oriented purposes; see the next section). We have developed a digital presentation tool that allows users to create a high-tech presentation from a library of images, animation, and full-motion digital video; alternatively, graphics can be imported using screen capture. The application has three modes: (1) review and import graphics and animation, (2) review full-motion video clips, and (3) organize all imported visuals. Once the presentation is finalized, a text reference file is saved, to be opened later for the actual presentation. TST continues to monitor developments in computer interaction and visualization to improve communication and define training needs.

Digital video has streamlined traditional editing production. TST's video production capability captures video images using analog cameras, then digitizes the source media using Motion JPEG compression for the final editing. The chief advantage of digital over analog broadcast is in the ability to view multiple video source tracks during the editing. Tracks are easily edited and can be changed back to a previous edit. Traditional VHS tapes can be created, or the digital format can be modified for various electronic formats.

The ability to edit and process video digitally has created new services as well as a new source of archival material. We are developing an archive of "mini-segments" from various APL programs and accomplishments. Information taken from fact sheets, Web sites, and other publications is condensed to a simple paragraph; narration is added to produce a 60- to 120-s video clip. Multiple clips of this type serve as a resource for brief Web messages and can be inserted into PowerPoint presentations. The archive is building resource material to help decrease the cost of creating multimedia titles.

Two basic digital video formats are available: QuickTime and MPEG. Both have unique features. QuickTime provides the best quality for playback over slow modems and works well for cross-platform compatibility between Windows, Macintosh, and most UNIX machines. The MPEG format, however, is the future of digital video. Today an APL Web test site can demonstrate full-motion/full-frame video. Using MPEG-1, the site streams VHS-quality video over APL's intranet at 512 kbits/s. Basic hardware video encoders are in place that allow live digitization of an analog signal of any event. The stream is then broadcast over the intranet for the APL community to view.

MPEG-2 video is also offered to deliver digital video in high-definition television resolution (HDTV). This file format is the standard for commercial DVD. We believe that DVD is the optical storage and distribution standard of the future. The next generation of video will go beyond interactive motion playback. MPEG-4 based on QuickTime will enable a whole new spectrum of media integration, including videophone, interactive mobile audiovisual communication, multimedia electronic mail, electronic newspapers, interactive computer imagery, sign language captioning, and more.

Currently we are taking advantage of some new features offered with multichannel QuickTime files. By layering scalable vector graphics (SVG) files into a separate video track, scripting is added to interact within the actual video file. This feature gives us total control of the video, incorporates hyperlinks and e-mail, and allows interactive animated vector graphics to be placed into the video.

CD "Business Cards"

The Laboratory's new business development, technology transfer, and staff recruiting efforts are enhanced by exhibiting APL's projects, accomplishments, and expertise at professional society conferences, trade shows, and museum/technology centers. In support of these critical undertakings, TSD's communications experts offer exhibit management services. Exhibits often can be built around technical illustrations and photographs created for other purposes and available in our archives.

Now, however, TST has created a new, powerful tool designed to deliver information about APL to a technically savvy population—a CD-ROM "business card." This new means of disseminating a high-tech message (Fig. 5) is a compact disk with the size and thickness of a standard credit card. It fits into a standard CD-ROM drive, holds up to 50 MB of data, and can be used at any workstation with a CD-ROM player. It can store information in many formats including PowerPoint, audio, video, graphics, animation, etc. This particular card holds a multimedia message that incorporates animated graphics and video with navigation. It allows the end-user to directly e-mail APL contacts or launch APL's external Web site.

Interactive 3D Visualization

A dynamic service that is available but still in development is virtual reality (VR). VR is bringing new ways of interfacing with the computer for visualizing

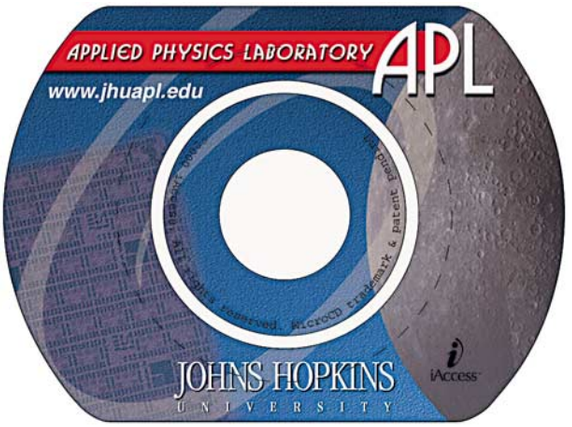

Figure 5. This TST-developed CD-ROM Business Card (http://techdigest.jhuapl.edu/td/td2104/businesscard.html) was created for the TechNet 2000 Conference. It holds a multimedia message with animated graphics and video with navigation.

information interactively in 3D. When it first emerged, the technology required high-end supercomputers with expensive peripherals (e.g., head-mounted displays, data gloves, tracking devices) to interact in the computer environment. In the past few years, the VR language has evolved into the Virtual Reality Modeling Language (VRML), bringing new solutions for Web and desktop applications. TSD's communications professionals offer this service using Apple's QuickTime VR (QTVR). QTVR is an image mapped inside a "cylinder." From a central observation point or node, the user can navigate or scroll around, zoom in and out to view the scene from different perspectives, "hold" individual objects, play video within the scene, click on "hot spots" to travel to other nodes, or activate other commands over a Web or multimedia application.

Multimedia is the new communications frontier, representing the integration of all communicative tools (pictures, video, animation, 3D, sound, databases, and words). It allows the user to choose information of interest and conveys that information with ease and clarity. Today workstations deliver multimedia; tomorrow our television sets may channel such services. The Laboratory's central resource for communications is positioned to offer and develop some of these tools, which will allow people to understand and explore information creatively. We are researching the technology and focusing on delivering it in the form of cost-effective products.

Our goals are to continue to incorporate advances in the art and science of communication, including DVD technologies, CDs that will allow users to travel inside a virtual environment, Web services with vector-based animation, graphics, full-motion video, etc. The future of multimedia is exciting and challenging, and promises to open up new possibilities for communicating ideas.

EXCELLENCE IN COMMUNICATION

The satisfaction of Laboratory staff with the support provided by TSD's central communications resource remains the first and most important criterion by which success must be judged. However, peer review is also an invaluable source of feedback.[5] Peer review is a measure of just how well we apply our skills and knowledge. Figure 6 shows four prestigious international awards

Figure 6. Excellence in communication is validated through peer review. (Clockwise from upper left): Award of Achievement for the *Digest Author's Guide* (STC 1998 Int. Competition: Art-Cover Design); 1998 Telly Award for "ACE—Exploring the Origins of the Solar System" video; Award of Excellence for the cover of the *Digest* 20(3), "DARPA at APL" (STC 1999 Int. Competition, Art-Cover Design); Distinguished Technical Communication Award and Best of Show for "APL Brochure" (STC 1998 Competition, Technical Publications: Informational Material).

won recently by TST staff. Our environment incorporates flexible teaming, customer involvement from the start, continual work flow improvement, attention to lessons learned with subsequent process redefinition, ongoing staff skills development, and evaluation of new technology. The awards validate the assessment that, in comparison with other similar efforts, we as communications professionals add value and help APL staff communicate their messages effectively.

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