Teaching fluid mechanics with born-again instructional VHS tapes

Bertrand Côté, P. Eng., M.A.Sc.

Associate professor
Department of civil engineering
Faculty of Engineering
Université de Sherbrooke
Sherbrooke, Québec
Canada J1K 2R1
bertrand.cote@courrier.usherb.ca

Abstract

This paper presents a case study describing why and how VHS instructional tapes were given a new life by reformatting them into numeric files. The tapes were produced in the mid-fifties by the Iowa Institute of Hydraulic Research (IIHR) under the apt supervision of Dr. Hunter Rouse. With IIHR's permission, large portions of the tapes were digitized in order to be able to use the excerpts in PowerPoint presentations, where they are more easily put into context with the use of equations, pictures and the like.

Dr. Hunter Rouse

Introduction

"This is your brain. This is your brain on drugs." Everybody remembers this famous TV add in which an egg was frying in a pan. Why was it so successful ? Because the movie spoke a thousand words. Simple. For many years, text books on Fluid Mechanics have relied more and more on pictures to illustrate physical phenomena. Unfortunately, pictures are static and are often inadequate to fully describe a physical occurrence of dynamic nature. The famous movie showing the collapse of the Tacoma Bridge (hyperlink1) does just that. This is why instructional courses on film or on tape have always been the ally of the astute professor. At the Université de Sherbrooke (Québec),

we have been using for many decades, tapes prepared by the University of Iowa's Institute of Hydraulic Research (IIHR) under the supervision of Dr. Hunter Rouse, a legend in the field of Fluid Mechanics. But the tapes have some drawbacks. First, they do not get through part of our French speaking clientele . Many students are trying to understand what is being *said* at the same time that they are trying to understand the demonstration. Second, not all parts of the tapes are relevant. We are more interested in some parts of the tapes, and thus have to fast forward the other parts, which distracts the students. It is difficult to skip easily to the next scene without some students losing attention. Third, some images depicting everyday life and showing, say, very old cars or *dépassé* hairdos will cause a collective laughter that requires a rewind in many occasions. We thus decided to do something in order to adapt the content of the tapes. By digitizing parts of the tapes, we figured that we would be able to short-circuit the language problem, while allowing us to use only portions that are of interest in the matter being taught, much like a CD player allows to skip to the next track, as opposed to a tape deck.

Permission

We first contacted IIHR to ask for their permission and we specifically requested that we may digitize portions of their tapes in order to use the excerpts for teaching purposes, with our assurance that proper credits would be given to IIHR. We were pleased that they accepted and we made sure that IIHR's logo was added to all PowerPoint presentations making use of any of the excerpts. We also sent them a copy of the first version of the CD-ROM that had been prepared. It was (and still is) an honour and a privilege for us to be associated with IIHR.

The making of the files

Portions of two tapes[1,2] were digitized by feeding the video signal of a VHS player in a Pentium 3-equipped IBM computer. This also required a video card (ATI's All In Wonder - Radeon) able to accept the analog signal. The resulting .avi files were then converted to Mpeg files with MGI's Videowave III software. This software is very easy to use and can produce montages very efficiently. A total of 83 video files, varying in lengths from a few seconds to a few minutes, were created.

The big picture

At the same time as we received a grant for our project from the *Service de soutien à l'enseignement*, the Department of Civil Engineering was undertaking a massive overhaul of its Bachelor's Degree program. Important objectives were to increase significantly the use of information technologies in the classroom and to come up with learning tools that would be appealing and effective in promoting self-learning. Using the video files hit the target right on in that respect.

PowerPoint environment

Movie files are better used in a PowerPoint environment, where the problem to be studied can be introduced, equations can be shown, and graphics can be used prior to viewing the physical phenomenon at hand. This section presents some examples illustrating the use of the Mpeg files that were created :

- Energy equation : the dancing rooftop (hyperlink2)
- Energy equation : cavitation (hyperlink3)
- Von Karman vortices : the collapse of the Tacoma Bridge (hyperlink4)
- Superposition principle : circulation around a moving cylinder (hyperlink5)
- Jet from an orifice : the trajectory problem (hyperlink6 and hyperlink7)

The benefits

The learning experience. It is our firm belief that learning Fluid Mechanics has to evolve into a sensorial experience, in an almost tactile way. Ideally, in the end, Fluid Mechanics has to be felt. By asking students to assimilate some concepts only on a theoretical basis accompanied by verbal descriptions and a limited set of still images, we are often asking them to believe without really seeing. What is learned that way will consequently be assimilated a lot more abstractly. The common bond between a lot of the great thinkers in our field (Pascal, Toricelli, etc.) was their keen sense of observation. By giving visual access to a varied set of physical phenomena, we are helping our students become better scientists with more ability to draw links between cause and effect.
The technical expertise. Having gone through the process of digitizing the movie excerpts, we evidently became more knowledgeable with the associated technology. We thus have gone on to produce some local movie presentations that are now being incorporated in various aspects of our teaching and of our research. As an example, some laboratory protocols now contain movie clips that enable students to work in smaller groups without direct supervision. Graduate students are also involved in the process, which is good. They are now able (and have the tools) to put together some simple montages of various clips, often incorporating footage collected in the lab and in the field.

Conclusion

Visual teaching aids will become more common in the near future, be it in the fields of sciences or humanities. Very recently, and interestingly enough, text books[3,4] on Fluid Mechanics have started to include a CD-ROM containing video files (hyperlink8). Also, as imaging technology becomes more and more user-friendly and run-of-the-mill computers gain more speed and memory, teaching will truly become a multimedia endeavour that will make use of homespun video presentations.
As budgets for lab technicians become tighter in our institutions, movie files of interesting phenomena that take place in laboratory demonstrations, which are time and money consuming to set up, will be produced only once and then shown in class or published on a CD-ROM.

Most of our Fluid Mechanics and Hydraulics laboratory protocols will be documented in a PowerPoint environment in the near future and will incorporate multimedia applications. This will enable our students to work in smaller groups and according to their own planned schedule (even at night), thereby helping them become more responsible citizens.

Bibliography

[1]Fundamental Principles of Flow, IIHR Video Tape
[2]Characteristics of Laminar & Turbulent Flow, IIHR video tape
[3]Young, D.F., Munson, B.R. and Okiishi T.H., A Brief Introduction to Fluid Mechanics, 2nd Edition, John Wiley and Sons, ISBN 0-471-36243-3, 2001.
[4]Munson, B.R.,Young, D.F. and Okiishi T.H., Fundamentals of Fluid Mechanics, 4th Edition, John Wiley and Sons, ISBN 0-471-44250-X, 2002.

Hyperlinks

Hyperlink1 : http://www.gci.usherb.ca/Hydro/ASEE/TACOMA.MPG
Hyperlink2 : http://www.gci.usherb.ca/Hydro/ASEE/Bernoulli.htm
Hyperlink3 : http://www.gci.usherb.ca/Hydro/ASEE/Cavitation.htm
Hyperlink4 : http://www.gci.usherb.ca/Hydro/ASEE/VonKarman.htm
Hyperlink5 : http://www.gci.usherb.ca/Hydro/ASEE/Circulation.htm
Hyperlink6 : http://www.gci.usherb.ca/Hydro/ASEE/Orifice.htm
Hyperlink7 : http://www.gci.usherb.ca/Hydro/ASEE/Trajectoire.htm
Hyperlink8 : http://www.gci.usherb.ca/Hydro/ASEE/Noslip2.htm

Biographical information

BERTRAND CÔTÉ has been affiliated with the Université de Sherbrooke since 1996. He was appointed Associate Professor in April 2001. His main interests are municipal engineering, water resources management and sustainable development. He is the proud father of two children, Émilie and Georges.