Digital Image Analysis Hardware/Software Use at U. S. Forestry Schools

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ABSTRACT: A survey conducted in 1988 indicated that approximately 70 percent of the forestry schools in the U.S. were operating at least one digital image processing package. One half of the schools had full image processing capability using either public domain or commercially available software. Most of these universities were utilizing the image processing technology to support both teaching and research programs. A few other schools purchased a low resolution image processing package for use in teaching or training exercises only. The survey establishes a baseline to compare what effect developing applications of satellite remote sensing in forestry may have on remote sensing teaching and research programs at the forestry schools in future years.

INTRODUCTION

IN EARLY 1988, a remote sensing survey of U.S. forestry schools was completed by the Society of American Foresters - Photogrammetry and Remote Sensing Working Group. The results of the education portion of the survey were published in the Journal of Forestry (Sader *et al.*, 1989). The second part of the survey focused on research activities and image processing equipment available at the forestry schools. The objective of the image processing component of the survey was to learn about what type of computer packages were being used in teaching and research programs at the forestry schools. The information pertaining to image processing capabilities at the U.S. forestry schools are summarized in this article.

Forty-four forestry schools returned completed questionnaires. The schools were requested to list the type of image processing hardware/software that was available within the forestry program and how many platforms were operating the software. For discussion purposes, we divided image processing software into two broad categories: full capability and limited capability. The distinction between the two categories was based primarily upon whether the hardware system included a high resolution image processor/monitor (16-32 bit system) as compared to a low resolution monitor (e.g., 4-8 bit) with a standard graphics card in a personal computer. Image processing routines are usually limited to display screen pixel resolution with the low resolution systems. Examples of the limited capability systems are APPLEPIPS/MICROPIPS, PCIPS-IBM,and DRAGON. Some of these packages are excellent teaching tools, but they are very limited for research.

IMAGE PROCESSING SYSTEMS AT U.S. FORESTRY SCHOOLS

Thirty-one of 44 U.S. universities that responded to the survey operated at least one digital image processing package in 1988 (Table 1). Of the 31 universities that reported image processing capability, nine of these had limited capability (low resolution) PC packages which were used primarily as teaching tools to introduce image processing to students. Twenty-two of the U.S. universities had what we defined as full capability image processing systems. Fourteen of these 22 forestry schools were using ERDAS software. Four universities were operating only public domain software or software developed in-house. Four universities operated other full capability commercial packages. Several universities possessed both public domain and commercial software packages operating on the same or different platforms. The most common public domain software packages were ELAS (NASA-Stennis Space Center), LAS(NASA-Goddard Space Flight Center, and VICAR(NASA-Jet Propulsion Laboratory). Some digital image processing packages developed in-house included ORSER (Penn State), A/DIPS (Univ. of Wisconsin – Madison), LIG-3 (Univ. of Michigan), and GIPSY(VPI). Some of the software written by the universities listed above was being used by forestry schools at universities other than where it was developed.

Several of the full capability public domain packages are difficult to learn and cumbersome to use (e.g., software bugs, no menus, incomplete and/or poor documentation). Public domain software has been developed in the research environment where user-friendliness is usually not a major design consideration. The less friendly nature of some public domain packages may limit their utility for teaching; however, faculty and graduate students often develop proficiency in using the software for research programs. The primary advantage of the public domain software is the low cost and the availability of source code which is useful for programmers who want to adapt the software and write modifications or new functions. The reader is referred to Jensen (1985) for more information on the hardware/software requirements and other capabilities of public domain and commercially available digital image processing software.

According to this survey, ERDAS was the most common commercial digital image processing software package available at the U.S. forestry schools in 1988. Twelve of the 14 forestry schools with ERDAS systems operated ERDAS on an IBM compatible personal computer. Decision Images, I²S, and Terra-Mar were other commercially available, full capability image processing packages in use at a few forestry schools. Two forestry schools were using Decision Images, two had I²S, and Terra-Mar was listed by one school. The proportion of all image processing packages used by U.S. forestry schools is depicted in Figure 1. Most of the schools operating the full capability systems indicated that the image processing packages were used to support both teaching and research. Tables 2 and 3 indicate the typical hardware requirements of the image processing packages that were in use at the forestry schools.

CONCLUSIONS

Approximately one-half of the U.S. forestry schools were utilizing image processing systems to support teaching and research programs. The forestry community has long been an operational user of aerial photos in support of forest inventory and management programs. However, at the present time there are few examples of operational users of satellite image processing in the forestry sector. The forestry schools, as a microcosm

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TABLE 1. DIGITAL IMAGE PROCESSING SYSTEMS AT U.S. FORESTRY SCHOOLS (1988)

University	Hardware/Software	# Platforms
Colorado State Univ.	Compac 386/ERDAS	3
	IVAS/I²S	1
	Micro-VAX/ELAS; LAS	1
Humboldt State Univ.	Leading Edge/Micropips	1
Iowa State Univ.	Apple III/Applepips	1
Louisiana State Univ.	IBM-AT/Decision Images	1
Michigan State Univ.	IBM-AT/ERDAS	3
	Cromemco/ERDAS 400	1
Michigan Tech. Univ.	IBM-AT/ERDAS	2
	IBM-XT/ERDAS	1
Mississippi State Univ.	Zenith-AT/ERDAS	1
No. Carolina State Univ.	VAX 11/780/LAS	1
No. Arizona Univ.	IBM-AT/ERDAS	1
Ohio State Univ.	IBM-XT/PCIPS (IBM)	2
Oregon State Univ.	IBM-XT/Written Internally	1
Penn State Univ.	IBM-AT/ERDAS	2
	Micro-VAX/VICAR/ORSER	1
Purdue Univ.	IBM-AT/ERDAS	1
	IBM/PC/Micropips	>5
So. Illinois Univ.	Apple II/Applepips	1
	IBM 370/ORSER	1
Steven F. Austin State Univ.	IBM/PC/PCIPS	>10
SUNY	IBM-AT/ERDAS	1
	SUN & Microvax/ERDAS	2
Texas A & M Univ.	VAX 1170/I²S	1
	Sperry IT/Terra Mar	>10
U of California, Berkeley	IBM-AT/Decision Images	1
	SUN/ELAS	1
	Micro-VAX/ELAS; LAS	1
Univ. of Georgia	IBM PS-250/ERDAS	1
	Zenith-XT/Micropips	10
Univ. of Illinois	IBM-AT/ELAS	>10
Univ. of Maine	IBM-RT/LAS	1
	Zenith-AT/ERDAS	1
	Zenith-AT/ELAS	2
	Zenith-AT/Micropips.EGA	4
Univ. of Michigan	Amdahl/LIG-3	>10
	Zenith-AT/LIG-3	1
Univ. of Minnesota	IBM-AT/ERDAS	1
	IBM PSII Model 80/	1
	Written Internally	1
Univ. of Missouri	COMPAC 386/ERDAS	2
Univ. Montana	IBM-PC/Micropips	1
Univ. New Hampshire	Apple II/Applepips	2
	Zenith 386/ERDAS	1
Univ. Vermont	VAX 750/ELAS	1
	AT & T 6300/DRAGON	1
U. of Wisconsin, Madison	IBM-AT/Written Internally	>10
Virginia Tech	VAX II/785/GIPSY	>5
	IBM-AT/Micro Image Proc (U.S. Army Corp. Eng.)	1
Utah State Univ.	VAX 8600/ERDAS; ELAS	>10
Washington State Univ.	Apple II/Imana	>5

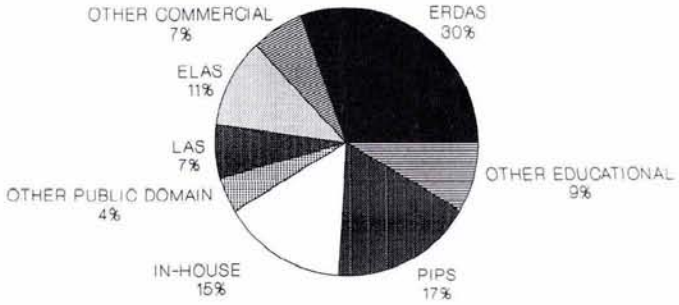

FIG. 1. Proportion of image processing software packages in use at U.S. forestry schools.

of the practicing forestry profession, appear to be half in and half out in terms of their interest and use of image processing technology.

If satellite remote sensing applications become more accepted as operational tools by the forestry community in the future (e.g., forest change detection for updating a GIS, regeneration surveys, type mapping), one might expect that the participation of forestry schools in satellite image processing would increase. This survey information was intended to gauge the level of activity by forestry schools in image processing. This survey establishes a baseline to compare the effects of technology development on the participation of forestry schools in image processing for teaching and research in future years.

It should be noted that the 1988 survey results may no longer reflect the current equipment and image processing capability at many of the universities that participated in the survey. The image processing technology changes rapidly over time and the survey information is just a snap shot from 1988.

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TABLE 2. DIGITAL IMAGE PROCESSING HARDWARE REQUIREMENTS FOR SOME LIMITED CAPABILITY PACKAGES AVAILABLE FOR PERSONAL COMPUTERS (ADAPTED FROM JENSEN (1986) AND VENDOR INFORMATION SOURCES)

System	Option*	Typical CPU/Image Processor	Pixels (Row/Col)	Bits/Pixel	Displayable Color vs Palate	Distributor
APPLEPIPS		Apple II, 48K	40 × 40 96 × 140	3 4	6/6	Telesys Group Inc.
MICROPIPS		IBM PC, 128K	160 × 100 200 × 320	4	6/16	"
MICROPIPS.EGA	1	IBM PC, 512K	200 × 320 350 × 640	6	16/64	"
PCIPS	1	IBM PC, 512K	200 × 320 350 × 640	6	16/64	IBM Corp
DRAGON	2,3	IBM PC, 640K	200 × 320 400 × 640	8	16/256	Decision Images

Note: Other systems are available from commercial vendors or in the public domain. This table includes only the common packages that were in use by forestry schools in 1988.

*1 EGA Graphics card
2 VGA Graphics card
3 Math co-processor
4 70 MB or larger hard drive
5 386 Machine

TABLE 3. DIGITAL IMAGE PROCESSING HARDWARE REQUIREMENTS FOR SOME FULL CAPABILITY PACKAGES AVAILABLE FOR PERSONAL COMPUTERS (ADAPTED FROM JENSEN (1986) AND VENDOR INFORMATION SOURCES)

System	Option*	Typical CPU/ Image Processor	Pixels (Row/Col)	Bits/Pixel	Displayable Color vs Palate	Distributor
ERDAS	1 or 2 3, 4	IBM AT, 640K #9**	512 × 512	32	16M/16M	ERDAS
		IBM AT, 640K #9	1024 × 1024	32		"
DECISION IMAGES	1 or 2 3, 4	IBM AT, 640K #9	512 × 512	24	16M/16M	Decision Images
	5	IBM AT, 640K #9	1024 × 1024	32	16M/16M	"
TERRA-MAR	1 or 2 3, 4	IBM AT, 640K N.A.	512 × 512	24	16M/16M	TERRA-MAR
	5	IBM AT, 640K	1024 × 1024	32	16M/16M	"
ELAS-PC	1 or 2 3, 4	IBM AT, 640K #9	512 × 512	32	16M/16M	Ray Seyfarth

Note: Other systems are available from commercial vendors or in the public domain. This table includes only the common packages that were in use by forestry schools in 1988.

* 1 EGA Graphics card
2 VGA Graphics card
3 Math co-processor
4 70 MB or larger hard drive
5 386 Machine

** Number nine computer company-graphics controller board