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Development of a University-Level Program in Electronic Imaging

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Abstract

Florida Atlantic University is home to what is probably the most concentrated university-based R&D effort in the world in the area of electronic imaging. The university is now beginning major investment in an accompanying academic program aimed at training masters- and doctoral-level students in this important technological area. Electronic imaging technology requires people trained in a wide variety of multi-disciplinary areas, with optics being a major component. This paper presents in detail our current assessment of those aspect of optics most important to students seeking professional development for R&D positions in a rapidly growing industry.

Summary

Introduction

Florida Atlantic University (FAU), located in Boca Raton, Florida, is the home of the world-renowned Imaging Technology Center and the NASA Research Partnership Center in Imaging Technology. Core areas of R&D activity in this laboratory, which operates in many regards like highly-successful industrial laboratories of the 1960s and 1970s, include ultra-high-definition video technology, ultrasonic imaging, video displays, high-resolution digital cameras, video compression, and related digital signal processing and other support areas. Recent laboratory developments, funded largely by NASA and Panavision, Inc., include an 8.3 mega-pixel progressive-scan CMOS-based camera operating at 30 frames per second. A second-generation, 12 megapixel 120-fps camera is on the way.

With this highly-successful R&D laboratory as a centerpiece, FAU is now embarking on a major effort to develop associated academic program elements for students interested in careers in the rapidly-growing area of electronic imaging, imaging technology, and imaging science. The general area is quite multi-disciplinary in nature, and a well-rounded program will include courses in high-speed digital circuit design and fabrication, digital signal processing, digital and analog signal distribution, optics, displays and electrical and optical properties of materials, visual and auditory perception, acoustics, and advanced electronic imaging.

Program elements

The optics-related program elements involve considerable material for the diligent student, as suggested by the following:

1) General course in optics: Geometrical optics, wave optics, lens aberrations, optical system design for camera and projectors, zoom lenses, anamorphic lenses, diffraction limit of resolution, lens field and field curvature, depth of focus, MTF of lenses and systems, film properties, color rendition, diffraction gratings, holography, schlieren optics (single and multiple), étendue limits, light sources, color temperature, electro-optic transducers, lasers, LEDs, OLEDs, plasmas, phosphors, sensors (CCD, CMOS, etc.) As can be seen, although many of the topics are typical of those found in an optical engineering course, some are unlikely to be found outside of an electronic imaging program.

2) Displays and electrical and optical properties of material: Electron optics, thermionic emission, field emission, liquid crystals, Bragg diffraction, space-charge limited conduction in

fluids, transmission active-matrix displays, reflective active-matrix displays, diffractive displays, color selection, field sequential, Beyer pattern filters, selection by diffraction, plasma displays, electroluminescent displays, LED displays, laser scanning displays, OLED displays, DMD displays, diffractive displays.

3) Visual and auditory perception: Sensory and neural structure of the eye-brain, sensory and neural structure of the ear-brain, contrast sensitivity function of luminance and color, temporal masking, spatial masking, ocular dominance columns, spatial frequency analysis the brain does in luminance, color processing by the brain, oblique effect, Weber-Fechner law, temporal response vs. spatial response, flicker perception, motion perception, eye tracking, accommodation vs. age, adaptation to color and luminance, surround influence on color perception, color and temporal response vs. brightness, binocular depth perception, Fletcher-Munson curves, binaural direction perception, Haas effect, hearing response vs. age.

Thoughts on the development of courses in these areas will be shared at the meeting.