Laboratory Internships
Enhance Learning Environment for Students

Randy K. Buchanan[1] and Jerry Walker[2]

Abstract

Helping students improve their laboratory skills has always been a priority for the faculty and staff within the Electronics and Computer Engineering Technology programs at the University of Southern Mississippi. The Electronics Engineering Technology (EET) program at the University of Southern Mississippi (USM) instituted a Laboratory Internship Program beginning the fall semester of 2002. Interested students were positioned with a specific lab course centered upon previously completed courses, past experience, and related interests. The responsibilities of the interns included lab-related tasks such as testing and setup. However, their principal duty was to provide student assistance during scheduled lab sessions. Data was collected from interns and students within the laboratory course, regarding the effect on learning processes, the ability to think critically, engage in teamwork, communicate, and increase their level of technical knowledge. Additionally, they were queried as to the effects of the unique learning environment and their ability to learn from someone other than the instructor. Analysis of the data indicated an extremely positive response from both interns and students in the areas queried. Participants appeared to be highly satisfied with the program and expressed that it benefited their overall educational experience. Due to the success of this program, other courses within the Electronics Engineering Technology program have instituted the Laboratory Internship Program.

Introduction

The Laboratory Internship Program was made available to ambitious students ranging from the sophomore to senior level. To some extent the goal of the program was to reduce the workload of instructors and produce higher quality students that met industry needs. The program was also intended to provide participants an enhanced learning experience through teaching.

The laboratory internships were made available for several classes, but were focused on the freshman level EET 101 Introductory Electronics course. This course is a first semester course designed to lay the groundwork for higher-level courses in most major areas of electronics. The laboratory is a co-requisite to the course, and includes a variety of practical experiences ranging from the fabrication of logic and relay circuits to regulated power supply design. Experiences in the laboratory guided students through measurement techniques involving the interpretation of voltage, current, resistance, and time measurements, as well as the operation of a waveform generator, a variable dc voltage power supply, and the use of analog and digital multimeters.

Previously collected data indicated that the interns benefited from their participation, both educationally and personally. [Buchanan, 1] In this most recent study, the effects on students within the academic course as well as the interns were examined. This new study varies from the original in that it focuses on the effects the interns have on the students in the learning environment, as well as issues related to the interns themselves. Data was collected from students within the course for the first time, and a greater number of interns were available for query.

The Interns

Six students participated as interns in the program for the fall 2003 semester. The interns assisted other students with laboratory procedures, experimental design approaches, equipment operation, troubleshooting, and measurement techniques.

[1] Electronics Engineering Technology, University of Southern Mississippi, Hattiesburg, MS 39406
[2] Electronics Engineering Technology, University of Southern Mississippi, Hattiesburg, MS 39406

The candidates selected for the Lab Internship Program were required to have a minimum 3.0/4.0 cumulative grade point average and to have completed at least six EET core course credit hours. The level of laboratory responsibility assigned to the intern was based in part on the technical courses that had been thus far completed by the student. Since the lab intern received credit for the course, near perfect attendance was expected and required. If the intern demonstrated a lack of discipline or appeared to be deficient in knowledge in the area of study, the student was asked to withdraw from the internship before the university deadline.

The interns assisted other students with laboratory procedures, experimental design, equipment operation, troubleshooting, and measurement techniques. They were instructed at the beginning of the program not to do the work for the students, but rather to assist in helping them understand and solve problems that may arise. All but one of the student interns were new to the program and had not experienced such an environment. They were required to sign a contract at the beginning of the semester that stated he or she agreed on the requirements for the program. A graduate student provided continual supervision and mentoring for the interns during the course of the semester.

Questionnaire

A questionnaire was given to each intern and student in the course. Questions included both technical and academic inquiries. The purpose of the questionnaire was to survey the effect of having interns in a laboratory course, both from the interns' and the laboratory students' perspectives.

Questions 1 through 4 were developed in conjunction with the program's continuous improvement process (CIP). The CIP is an ongoing process that examines the academic program's outcomes and objectives, solicits assessment from students, graduates, and alumni; and provides a feedback mechanism for program improvements. By definition, the program outcomes are those attributes that a student has upon graduation, and educational objectives are related to what graduates have 2 to 5 years after graduation. [ABET, 2] Questions 5 and 6 were developed in an effort to gain insight into the effects on the educational and learning processes within laboratories that student interns were immersed.

Intern Response

The interns were asked to rate their level of agreement with questions about their laboratory experience from 1 to 5; 5 being the highest level of agreement and 1 being the lowest agreement level. The questionnaire provided an option for stating any particular question was not applicable to an intern's individual situation. Questions asked of the interns are shown in Table 1.

Student Response

The students were asked to rate their level of agreement with questions about their laboratory experience with the interns from 1 to 5; 5 being the highest level of agreement and 1 being the lowest agreement level. Students were provided an option for stating any particular question was not applicable to a student's individual situation. Questions asked of the students are shown in Table 2.

Data Analysis

Evaluations of the perceptions of the interns toward the internship experience were collected and tabulated. Additionally, evaluations of the perceptions of students in the laboratory course were gathered and evaluated. Since the questionnaires were developed with data analysis in mind, their quantitative nature made translation to spreadsheet format relatively straightforward. Once in spreadsheet form, the data was easily sorted, manipulated, and graphed for interpretation. A comparison of student vs. intern responses for similar questions is shown in Figure 1.

Table 1. Laboratory Intern Questions

Please circle the response that best matches your perception of the effects the laboratory internship program has had on you and your abilities.

CRITICAL THINKING
To what extent do you feel the laboratory internship has positively affected your ability to think critically?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

TEAMWORK
To what extent do you feel the laboratory internship has positively affected your ability to perform successfully as a member of a team?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

COMMUNICATION
To what extent do you feel the laboratory internship has positively affected your ability to orally communicate effectively?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

TECHNICAL KNOWLEDGE
To what extent do you feel the laboratory internship has positively affected your ability to increase your technical knowledge, skills, and abilities related to electronics engineering technology?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

SUPERVISORY RESPONSIBILITY
To what extent do you feel the laboratory internship has positively affected your ability to supervise students with exercises in a laboratory environment?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

TEACHING
To what extent do you feel the laboratory internship has positively affected your ability to teach others in a laboratory setting?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

Table 2. Student Questions

Please circle the response that best matches your perception of the effects the laboratory internship program has had on you and your abilities.

CRITICAL THINKING
To what extent do you feel having student laboratory interns in the lab has positively affected your ability to learn how to think critically?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

TEAMWORK
To what extent do you feel having student laboratory interns in the lab has positively affected your ability to perform successfully as a member of a team?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

COMMUNICATION
To what extent do you feel having student laboratory interns in the lab has positively affected your ability to orally communicate effectively?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

TECHNICAL KNOWLEDGE
To what extent do you feel having student laboratory interns in the lab has positively affected your ability to increase your technical knowledge, skills, and abilities related to electronics engineering technology?

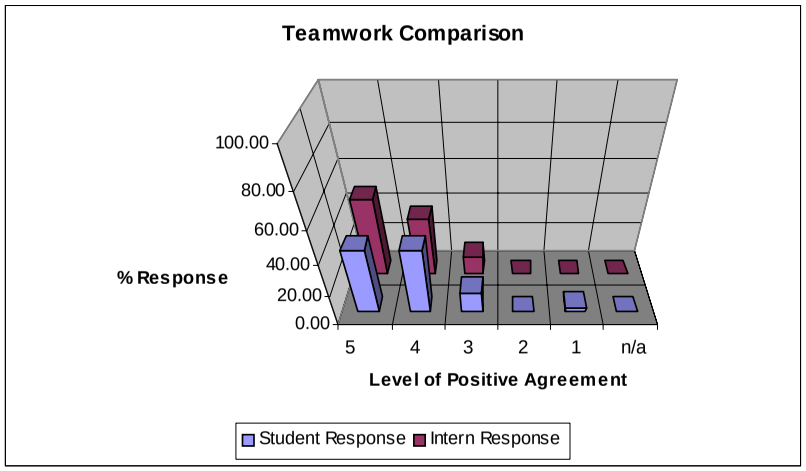
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

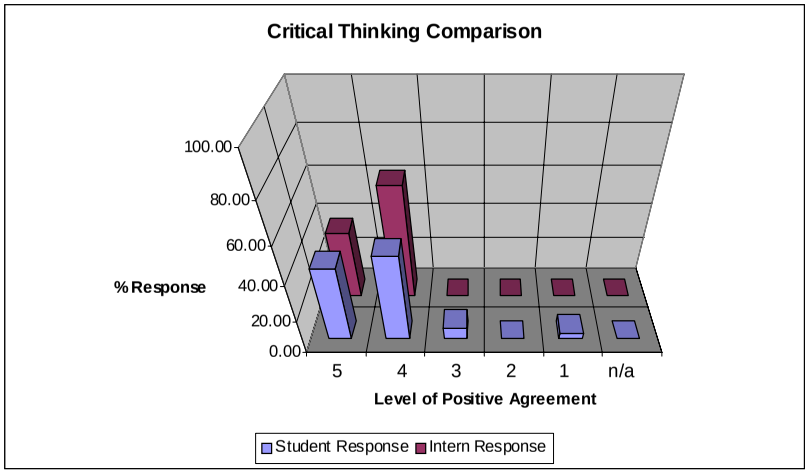
LEARNING ENVIRONMENT
To what extent do you feel having student laboratory interns in the lab has positively affected the ability to learn in a laboratory environment?

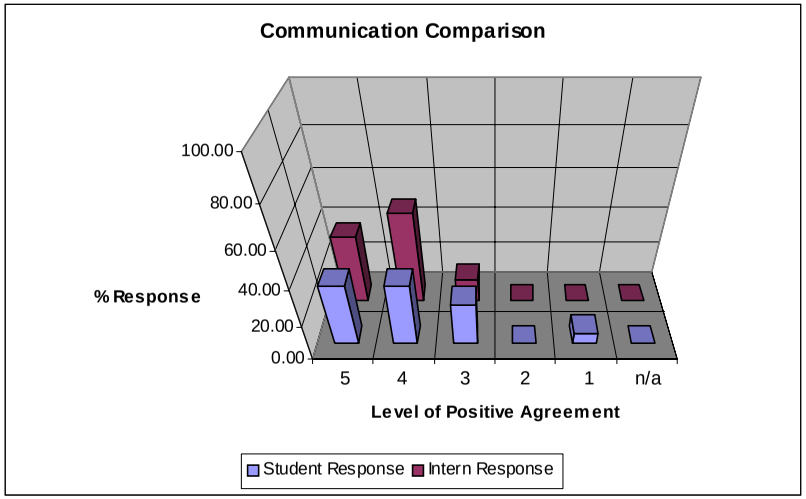
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A

INSTRUCTION
To what extent do you feel having student laboratory interns in the lab has positively affected your ability to learn from persons other than your instructor, such as graduate assistants, lab interns, and fellow students?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
5	4	3	2	1	N/A







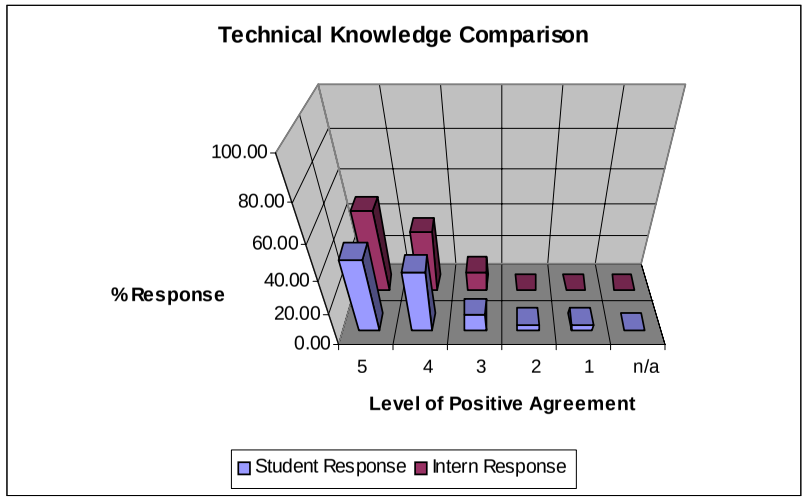


Figure 1. Comparison of Similar Questions for Students and Interns

Intern Data Analysis

The interns were asked to answer the questions presented in Table 1. Personal communication with the interns indicated that they felt they had a very effective presence in the laboratory. By examining the questionnaire data, it was apparent that the interns felt the laboratory experience had a positive effect on their abilities to think critically, work as a team, and communicate. In addition, most interns indicated that their internship provided them with an increase in technical knowledge and supervisory skills. Tabulated results from the intern questionnaires are indicated in Table 3 and illustrated in Figure 2.

Table 3. Intern Questionnaire Results

INTERN QUESTIONS	5	4	3	2	1	n/a
%	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	NOT APPLICABLE
CRITICAL THINKING	37.50	62.50	0.00	0.00	0.00	0.00
TEAMWORK	50.00	37.50	12.50	0.00	0.00	0.00
COMMUNICATION	37.50	50.00	12.50	0.00	0.00	0.00
TECHNICAL KNOWLEDGE	50.00	37.50	12.50	0.00	0.00	0.00
SUPERVISORY RESPONSIBILITY	37.50	62.50	0.00	0.00	0.00	0.00
TEACHING	50.00	50.00	0.00	0.00	0.00	0.00
Total Intern Responses	***8***					

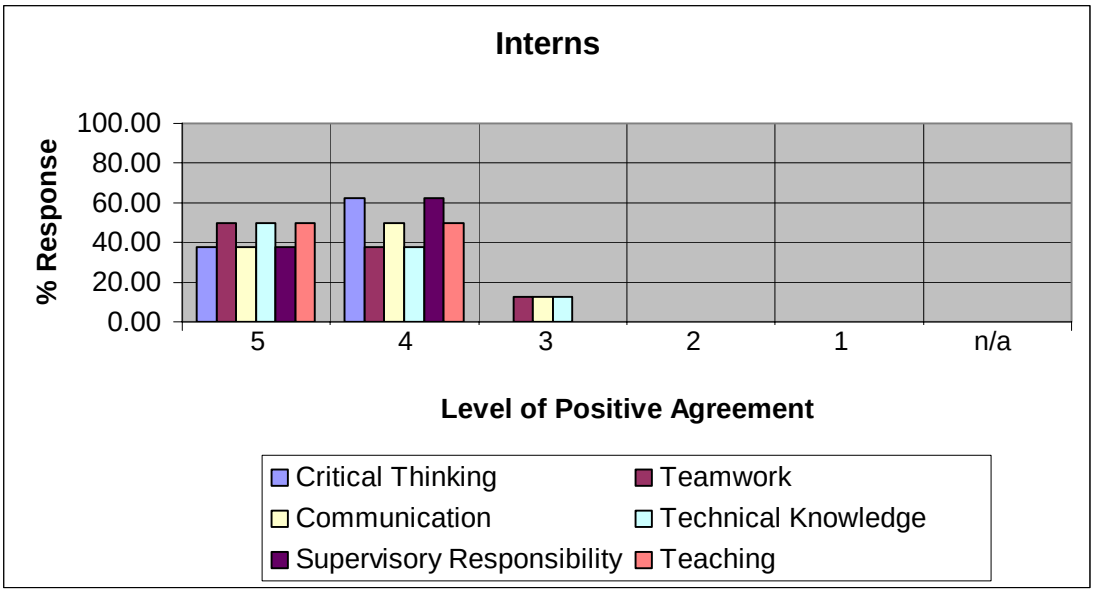


Figure 2. Intern Questionnaire Results

Student Data Analysis

The students were asked to answer the questions presented in Table 2. Many students had stated throughout the semester that the interns had a very effective presence in the laboratory. By examining the data, it was evident that the students felt the laboratory experience had a positive effect on their abilities to think critically, work as a team, and communicate. In addition, most interns indicated that having the interns in the laboratory provided them with an increase in technical knowledge and ability to learn the material. Tabulated results from the student questionnaires are indicated in Table 4 and illustrated in Figure 3.

Table 4. Student Questionnaire Results

STUDENT QUESTIONS %	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	NOT APPLICABLE
CRITICAL THINKING	41.38	48.28	6.90	0.00	3.45	0.00
TEAMWORK	41.38	41.38	13.79	0.00	3.45	0.00
COMMUNICATION	34.48	34.48	24.14	0.00	6.90	0.00
TECHNICAL KNOWLEDGE	44.83	37.93	10.34	3.45	3.45	0.00
LEARNING ENVIRONMENT	31.03	65.52	65.52	0.00	3.45	0.00
INSTRUCTION	44.83	37.93	13.79	0.00	3.45	0.00
Total Student Responses	***29***					

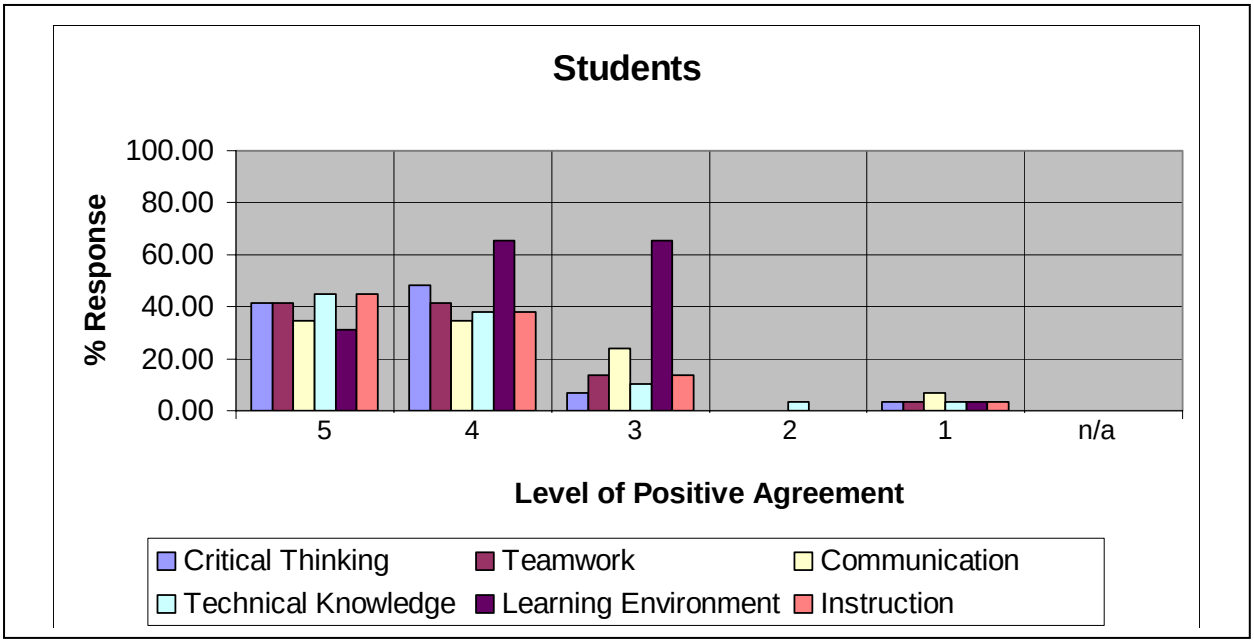


Figure 3. Student Questionnaire Results

Discussion

Data evaluation indicated that 41% of the students strongly agreed and 48% agreed that the laboratory internship positively affected their ability to think critically, totaling an 89% favorable response, with 13% remaining neutral. Students, however gave a 38% strongly agree - 63% agree response, meaning that the students agreed 100% that having student interns in the lab had positively affected their ability to learn how to think critically.

The interns indicated they gained an enhanced understanding of the technical information presented in the laboratory. Examination of data collected concluded that students benefited with an increased understanding of the technical subject matter by having lab interns. Students expressed an increase in technical knowledge as 45% strongly agree and 48% agree. This indicated that 93% of the students felt the interns helped them learn more. Likewise, 100% of the interns felt that they also increased their technical knowledge by being lab interns.

In terms of teamwork, data indicated that the interns and students felt they gained an increased exposure to teamwork processes. A positive response was stated by 82% of the students and 88% of the interns. With 14% and 13% neutral response for students and interns respectively, only 3% of the students and none of the interns indicated a negative response.

Students deemed the learning environment was positively enhanced by a 97% response. Likewise, 93% felt having student laboratory interns in the lab positively affected their ability to learn from persons other than their instructor, such as graduate assistants, lab interns, and fellow students.

Interns rated their ability to supervise students with exercises in a laboratory environment as a 100% positive response. They also rate with a 100% positive response, their ability to teach others in a laboratory setting that resulted from their laboratory internship experience.

Although most interns felt the commitment of being a laboratory intern demanded more time than originally expected, they also expressed that the experience was well worth the time invested. Personal communication also indicated a perceived increase in confidence that was the result of being placed in a pseudo-supervisory position.

Conclusions

Participants appeared to be satisfied with the internship program and expressed a high level of satisfaction with the benefits to their overall educational experience. It was the opinion of students and faculty alike, that the level of continuous student-to-student interaction made the presence of the interns very evident, when compared to other laboratory sessions. Observations indicated that the interns as a whole provided considerable more contact time between the assister and the assisted than would ever had been possible with a single instructor. The related activities of prepping labs, testing, troubleshooting, working on a team, etc., were additional practical products of the internship. The students treated the interns with respect and considered them authority figures in relation to procedures within the laboratory.

Data collected demonstrated that the laboratory internship program is deemed to very valuable to the interns involved and the students within the laboratory. The interns gained a new perspective into laboratory procedures, having experienced the other side of instruction. They were required to be accountable for their knowledge and the dispersion of it, since students depended on them.

Overall, the Laboratory Internship Program appeared to allow the interns to develop as students and individuals. This process allowed the interns to gain confidence, which consequently produced social skills necessary for communication with other students and for use in future roles with industry. This essentially simulated real world experience by allowing the interns to work in a professional supervisory role. During laboratory sessions throughout the semester, interns were placed in situations that required them to lead and direct students through various technical procedures.

Students enrolled in the courses for which lab interns were assigned benefited from the ease of accessibility, communication, and approachability of the interns. Students also benefited from young and enthusiastic student interns who were more than willing to help someone for the first time. The amount of personal contact time provided by the interns to the students could not be humanly possible to accomplish for one instructor.

The university benefited from an improved academic process with extensive student participation. It is anticipated that such student involvement will produce stronger and more productive students and graduates in the future, which will reflect well on the program and the university. Due to the success of this program, expansion into other courses within the Electronics Engineering Technology program has already begun.

References

[1] Buchanan, Randy K., Chesser, Brett. “Students Gain Experience through the Laboratory Internship Program,” American Society for Engineering Education Southeast Section Conference Proceedings. April 2003, Mercer University, Macon, GA.

[2] Retrieved September 21, 2003 from the World Wide Web: http://www.abet.org

Randy K. Buchanan

Professor Randy Buchanan is Coordinator of Electronics Engineering Technology at the University of Southern Mississippi (USM) in Hattiesburg, MS. He has been on the faculty at 3 universities in 2 states, and directed projects at 4 different NASA centers. He is currently director of the NASA EPSCoR Mississippi research project at the USM Signal Research Center. He is the Chair for the ASEE SE Electrical Engineering Division and an active in the Instrumentation, Systems, and Automation Society. His areas of research and interests include control systems, scientific instrumentation, laboratory automation, space hardware processing, and planetary & space simulation. He recently received NASA Space Act Software Invention Award and a NASA Space Act Board Action Invention Award for the design and implementation of the Mars Electrostatics Chamber at Kennedy Space Center in Florida.

Jerry Walker

Jerry Walker obtained his B.S. Degree in Computer Engineering Technology from the University of Southern Mississippi, and is currently a Graduate Assistant in the School of Engineering Technology at the same institution. Jerry assists with both research and academic tasks within the electronics program area. His areas of interest include controls, instrumentation, computational methods, and digital signal processing.