

Communication and Signal Processing using Vertically Integrated Projects (VIP)

David J. Love

Associate Professor, School of Electrical and Computer Engineering, Purdue University

Abstract

The Vertically Integrated Projects (VIP) program at Purdue is an innovative project-based learning set-up for undergraduates. VIP couples undergraduates, graduate students, and faculty in a meaningful research partnership. VIP provides students with a deeper understanding of their coursework, leadership and mentoring experience, and access to new cutting-edge research ideas. The communication and signal processing program at Purdue has used the VIP program for multiple successful projects

Introduction and Objectives

❑ VIP program resolves major issues with engineering education

1) Undergraduates and M.S. students

- Focus their studies on broad engineering coursework
- Not given opportunities to apply coursework knowledge in a research project setting

2) Ph.D. students

- Work on theory-based research
- Never able to see many of their ideas implemented and tested

❑ **Objective:** To perform project-based learning by undergraduates under the close direction of graduate students and faculty

Developmental History

❑ VIP program started from 2003

❑ VIP program has been grown **substantially** with time

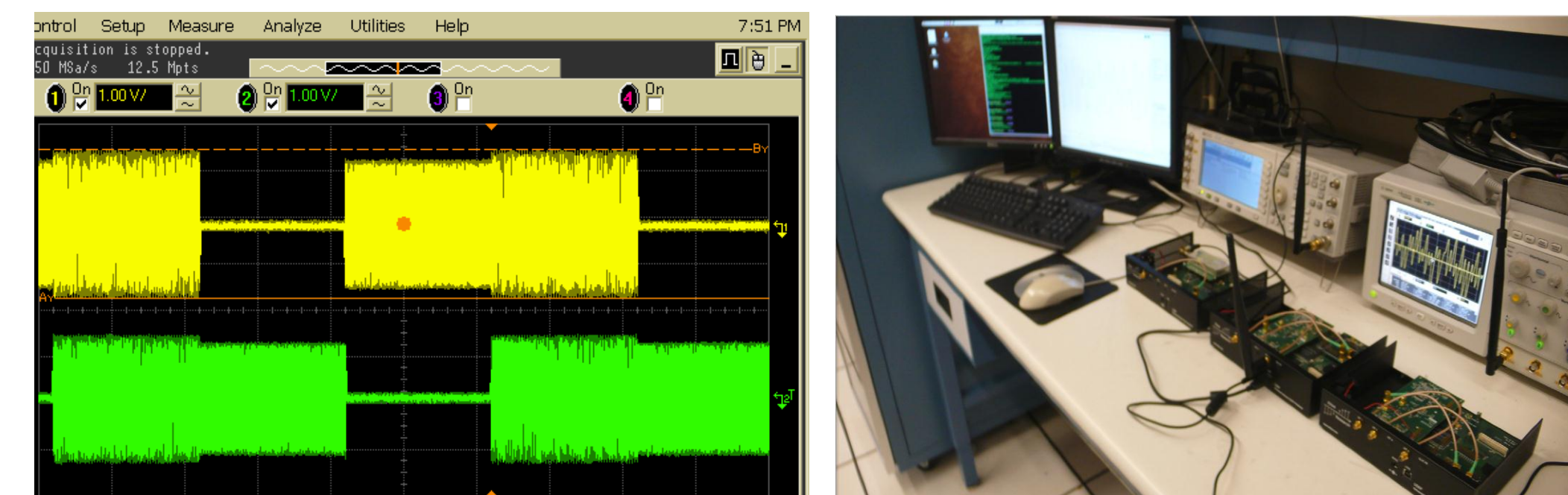
Spring 2009	37 Members
Fall 2009	37 Members
Spring 2010	40 Members, 9 Teams
Fall 2010	49 Members, 9 Teams
Spring 2011	65 Members, 9 Teams
Fall 2011	79 Members, 11 Teams

❑ Comm & signal processing team
Since Fall 2008, Total members: 42

Current Projects

Communication systems development module

- Prototyped different communication and signal processing systems

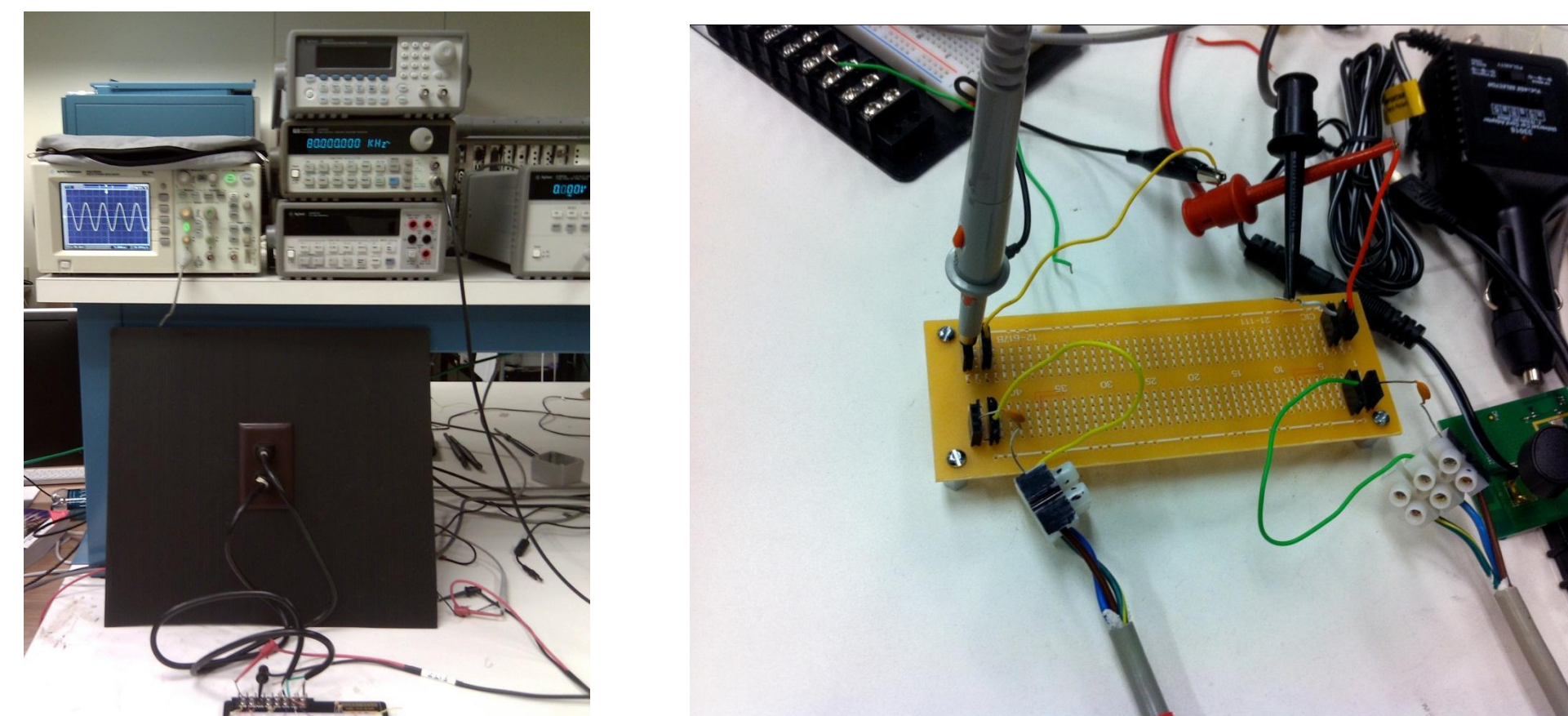


Time-domain scope of systems testing

USRP and working environments

Power line communication systems module

- Designed a communication system that transmits/receives data through a common power line



Power line communication setup

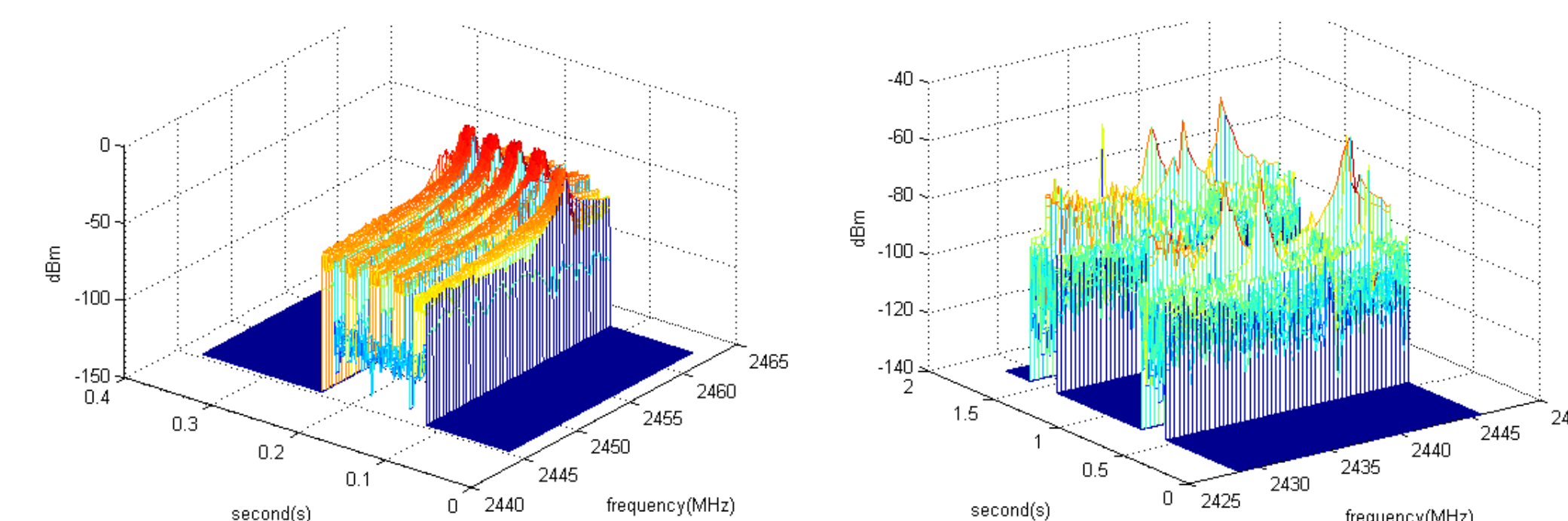
System testing

Spectrum sensing application module

- Developed an interference detection application to measure interference from consumer products



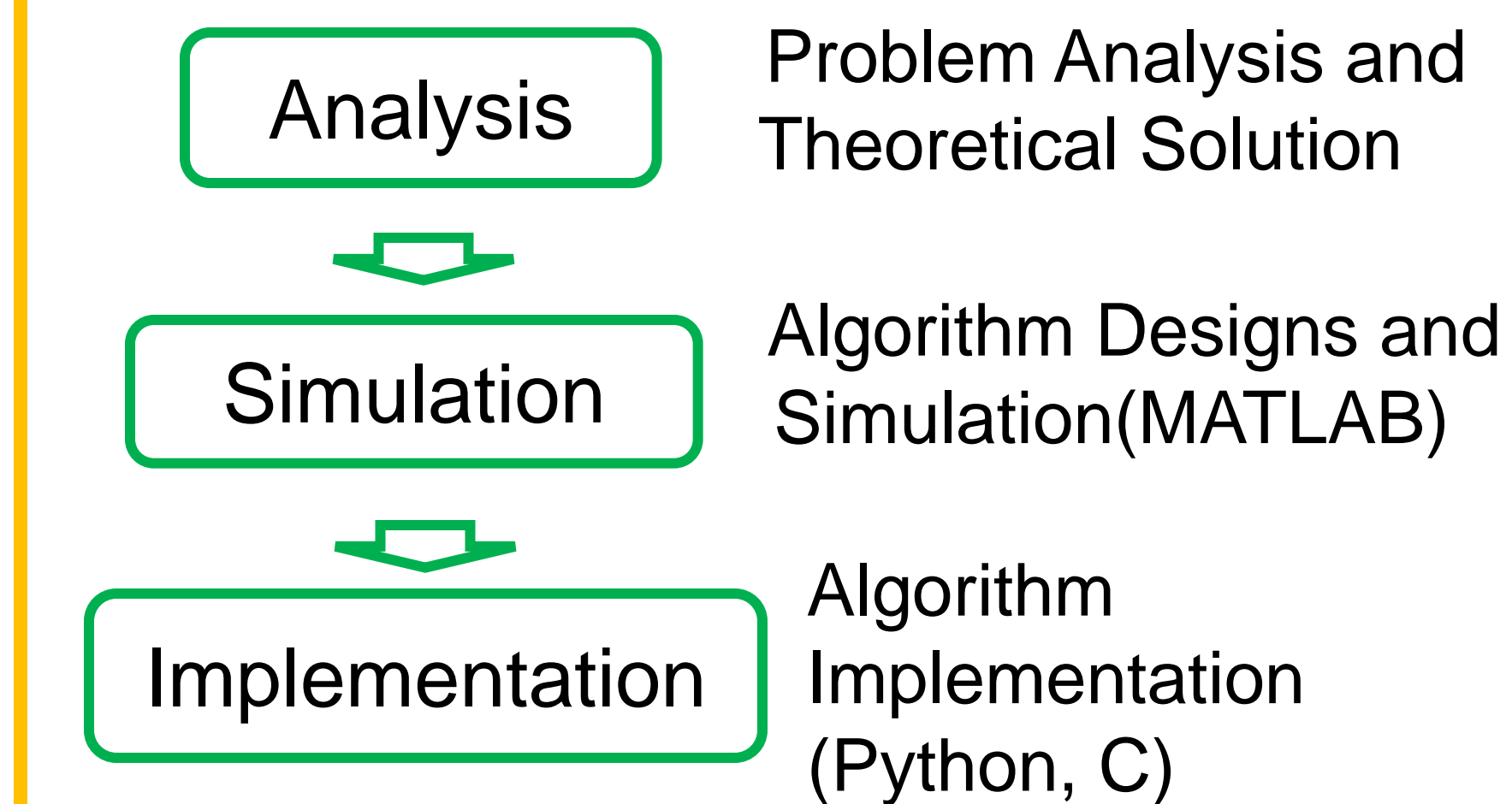
Aruba Networks controller and access points



Power spectral density of a typical microwave oven and typical Bluetooth devices a function of time

Educational Structure

- ❑ Students have weekly meetings with graduate students and faculty.
- ❑ Evaluation done by module progress, research outcomes, oral exams, and oral presentations
- ❑ Projects often have industrial partners



Future Improvements

❑ Theory and application of new engineering education methods to evaluate students' performance and progress in project-based courses

❑ Mentoring and guiding M.S & Ph.D. students

❑ Improving student leadership

❑ Teaching methods in engineering education to develop and improve the VIP program

❑ Improve the integration of undergraduate research members in VIP using innovative group collaboration

❑ Development of new research projects recruiting upper-level undergraduate research members

❑ Recruiting more industrial partners

Discussion

- ❑ VIP has become a successful and popular communication & signal processing systems project-based course for undergraduates and graduate students
- ❑ Growth and improvement of this program and applying new engineering education methods
- ❑ Integrate model into senior design projects and labs associated with courses (e.g. Signals and Systems, Transmission of Information, Digital Signal Processing)
- ❑ Increase industrial interaction

Acknowledgments



Collaborators: Prof. J. V. Krogmeier
Prof. C. C. Wang, and over 42 students

For Further Information

Please contact djlove@ecn.purdue.edu

2011 Frontiers of Engineering Education Symposium

Irvine, California
November 13 - 16

Sponsored by:

The National Academy of Engineering and

The O'Donnell Foundation

