LAKE SUPERIOR STATE UNIVERSITY

OFFICE OF THE PROVOST

APPLICATION FOR SABBATICAL LEAVE
(*Refer to Section 15.4 of the Faculty Association Agreement*)

I. Name David McDonald Date Nov 15, 2010

Department Engineering Ext. No. 2208

Home Address [redacted] Home Phone [redacted]

II. Application for leave during the following (*indicate semester and/or year*):

Fall _____ Spring _____ Full Year X

III. Number of years of faculty service (*minimum of 5 years required*) 37

IV. Tenure status (*tenure required*) Tenured

V. Semester or year of last sabbatical (*if applicable)* 1996-97 (12 cr)
(*minimum of 5 years since last sabbatical required*)

VI. Title and description of sabbatical project (*attach pages as appropriate*). Include in the description a discussion of at least one of the following criteria:

1. The strength of the relationship between a sabbatical leave proposal involving applied or theoretical research related to professional activities and the advancement of knowledge within disciplinary areas.

2. The strength of the relationship between a sabbatical leave proposal involving an external, professionally-related experience/study in a business, industrial, health care, scientific or educational setting and the improvement of instructional/professional activities at the University.

3. The strength of the relationship between a sabbatical leave proposal involving travel or advanced study and its yield in improving the quality of instruction at the University.

VII. Attach a statement agreeing to return to the University.

Sabbatical Application for 2011-2012
David McDonald

Overview:

There have been many major changes in the field of electrical motor applications, types of motors, and power electronics / motor drives in recent years. The following information will highlight some of those changes. It will also forecast a sabbatical application with activities that are intended to improve instruction in the Electrical Engineering degree program at LSSU related to energy conversion and motor control coursework.

Hybrid/Electric Vehicles (HEV and EV) are becoming more common. In addition, Electric Vehicles (EV) will soon be mass produced for the first time in history, and their existence will play a vital role in the emerging Smart Grid. Plug-In-Hybrid (PIV) vehicles can be recharged during off-peak times when electricity demands are low, and numerous PIVs will essentially provide a nation wide storage network. The expansion in HEV and EV has created a demand for engineers and technicians in that area.

Electrical motor and motor control instruction has traditionally been directed at students who would be designing and manufacturing those systems. However, much of the design work has been outsourced overseas, and jobs in the US now focus more on the application and integration of this technology.

New high-efficiency motors and controllers are dominating the electric vehicle market and emerging in industrial applications. Unfortunately, motor and motor control instruction in many universities, including LSSU, mainly focuses on traditional line voltage fed systems. LSSU does not currently have the resources of new systems where the line voltage is fed to the controller and modern digital signal processing technology and power electronics combine to control the motor. These high efficiency motors run on software where complex algorithm calculations are performed thousands of times per second. I personally have worked with motor/controller developmental units that had a combined efficiency greater than 95%.

Many universities are responding by: 1) developing new courses and programs in advanced power electronics and controls or hybrid/electric-drive vehicle engineering, and 2) Re-engineering motor/controller instruction to emphasize the new technology. However, LSSU has neither instructional experiences nor laboratory technology in modern electro-mechanical energy conversion, modern motor drives that are based on power electronics, or hybrid/electric vehicle drive train systems. The result is that electric motor and power conversion instruction at LSSU has not changed in over 40 years.

A hybrid/electric vehicle can be a fertile bed for instruction because it is a timely topic that everyone can relate to it. More importantly, it supports the study of both higher, system level interfacing and lower level details. Issues regarding the interfacing of energy storage, energy conversion, controls, motors, electronics, bus communication technology as well as safety and

operator drive profile considerations are all present in electric vehicles. Therefore hybrid/electric motor drive trains can support both system level study and in-depth study in one or more the specialty areas.

This sabbatical application will enhance the ability of LSSU to support instruction in the area of modern electric motors and motor control engineering including electric-drive vehicle engineering. This will occur through a balance of professional development, networking with professionals, acquisition of resources, and creation of new instructional activities in the new technology.

Specific sabbatical activities will include a combination of:

1. Taking graduate courses in the area of energy conversion, power electronics, electric motor drives, or electric drive technology from a South East Michigan school such as courses in a new Electric Drive Vehicle Engineering program at Wayne State University or MS Electrical Engineering program at UM Dearborn, Oakland University, or Kettering University.

2. Networking with practicing engineering experts in the field, and with engineering faculty in South East Michigan who work or teach in the areas of motor/controllers and hybrid or electric vehicles.

3. Developing student learning experiences in motor controls and hybrid/electric vehicle technology.

4. Review the previously submitted NSF grant proposal, and possibly resubmit a revised version in the area of energy conversion and modern motor control systems.

Outcomes of the sabbatical will include faculty professional development, development of one new course, revision of another electrical engineering courses, development of new student learning experiences that can be used in multiple courses, and professional papers on instruction tools and techniques with the new technology.

Goal:

The sabbatical will enable development of faculty competency and new laboratory instructional activities that will help prepare students for employment and graduate school in the areas of electric vehicle engineering, modern motor integration development, and/or hardware/software-in-the-loop technology for embedded motor control validation.

Objectives:

The attainment of new competencies and activities will be achieved via completion of the following objectives:

1. Completion, on a credit or audit basis, graduate engineering courses related to new developments in electric motors, power electronics, electric-drive, or vehicle electronics.

2. Development of a hardware-in-the-loop and/or real-time motor controller educational experience that can be refined and reproduced at LSSU for use in upper level courses.

3. Restructuring of the EGEE330 Electric Machinery course to reduce legacy content and develop learning experiences in the new technology.

4. Develop learning experiences for a new Hybrid/Electric Vehicle Systems course (initial offering of EGEE400 scheduled for Spring 2011).

5. Network with industry professionals and faculty/staff in Michigan universities that offer course work in electric drive technology to better understand required resources such as equipment that will support the course development activities.

Activities:

The objectives will be met by completion of the following activities:

1. Completion of a minimum of two graduate classes from a SE Michigan area university in the area of electric vehicle or advanced vehicle electronics. At this point I have visited the Electrical Engineering departments at Wayne State University, UofMichigan Dearborn, and Oakland University. I expect to visit Kettering in late November.

   There has been government funding directed at some Michigan schools to develop educational experiences in this technology at all levels. Wayne State recently received a $5.5 M grant to develop the new program in Electric Drive Vehicle Engineering. UM Dearborn, Kettering and MTU have also received grant funds and are developing hybrid/electric vehicle courses.

   Neither the institution nor the specific courses have been selected because of pending new developments in these programs, and the desire to meet directly with the instructor of specific courses. The selection criteria will include course topics, match with interests and experiences, and suitability for replication at LSSU. The plan is to take not more than one or possibly two classes each semester in order to achieve optimum benefit from the course.

Wayne State University
http://www.eng.wayne.edu/page.php?id=5909

Tuition: $556/credit + fees, Classroom. If taken for credit, completion of 12 credits results in a Graduate Certificate in Electric Drive Vehicle Engineering

a. EVEE 5110 Fundamentals of Electric Drive Engineering
b. EVEE 5130 Electric-Drive Vehicle Modeling and Simulation
c. EVEE 5410 Power Electronics and Control
d. EVEE 5430 Modeling and Control of Electric-drive Powertrains
e. EVEE 5450 Control & Optimization for Integrated Electric Drive Systems
f. EVEE 5640 Energy and the Environment

University of Michigan Dearborn
http://www.engin.umd.umich.edu/ECE/grad_prog/descrip.php
Tuition: $720/credit ($620 + $100 web fee) + fees, All classes are On-Line

a. ECE 515 Vehicle Electronics
b. ECE 517 Advanced Industrial Drives and Motor Controls
c. ECE 546 Electric Vehicles
d. ECE 5462 Electric Aspects of Hybrid Electric Vehicles
e. ECE 5121 Modeling and Design of Electric Circuits and Systems

Oakland University
http://www2.oakland.edu/secs/ECEdept/gradstudinfo.asp
Tuition: $530/credit + fees, apparently all classes are classroom

a. ECE 525 Instrumentation and Measurements
b. ECE 557 Energy Conservation Systems
c. EECE 678 Automotive Vehicle
d. SYS 575 Automotive Mechatronics
e. SYS 674 Digital Control Systems

Kettering University (not visited yet)
http://www.kettering.edu/futurestudents/graduate/mseece_curriculum.jsp
Tuition: $695/credit + fees, apparently all classes are taught in classroom with live streaming for web-based students that is also recorded.

a. EES 580 Automotive Electrical Systems
b. ECE 610 Modeling Circuit Systems
c. ECE 642 Electric Machine Drives
d. MECH 545 Hybrid Electric Vehicle Propulsion

2. Development of a minimum of one Hardware-In-the-Loop (HIL) learning experience including prototype hardware and software pending access to or acquisition of necessary software and hardware. This will be used by future students in motor integration and electric vehicle drive instruction. It can also be used as a digital controller in the EGRS462 Design of Control Systems course.

3. Revision of the EGEE330 Electro-Mechanical Systems course to reduce legacy content and integrate learning experiences in power electronics and high-efficiency machines. The challenge here is that textbooks have not changed much in 40 years.

4. Development of a new EE400 Hybrid/Electric Vehicle Systems course. This course is currently being proposed as a special topics course for Spring 2011. This initial offering will be evaluated and revised for future offerings.

5. Networking with like-minded education and industry professionals via monthly and sectional conferences of IEEE, SAE, and other similar groups as well as visiting undergraduate engineering programs in SE Michigan school to review laboratory resources and curriculums.

6. Evaluation and possible revision/resubmission of a NSF grant proposal in course and curriculum development in engineering in the target content area. Concerns about simply resubmitting a prior proposal that are addressed on the appropriate attachment.

Timeline:

The following timeline will be used to evaluate the status of activities, and will enable prioritizing objectives and activities for optimum project outcomes.

November 2010 – March 2011

- Investigation of educational opportunities in the SE Michigan area.
- Networking with like-minded professionals to optimize access to resources.
- Teaching of EE400 Electric Vehicle Systems Course

April – May 2011

- Teaching of EE400 Electric Vehicle Systems Course
- Revision and resubmission of NSF Grant

June - August 2011

- Independent study and start work on new instructional laboratory experiences

September – December 2011

- Graduate level course
- Continued networking with other faculty and industry professionals.
- Continued work on controller/HIL learning experience(s)
- Mid-point assessment of sabbatical activities and establishment of priorities and resource requirements for remainder of the sabbatical.

January – May 2012

- Graduate level course
- Continued networking with other faculty and industry professionals
- Continued development of new instructional learning experiences

June - August 2011

- Assessment of sabbatical activities, definition of outcomes and establishment of plans and priorities for integration of developed learning experiences and products.

Sabbatical Assessment:

Both a mid-point and final assessment of the sabbatical activities will be performed. The midpoint assessment will focus on progress to complete planned activities, modifications or adjustments in activities to better achieve goals, and tuning of planned activities for the remainder of the sabbatical. The final assessment will consist of a summary report of completed items and general sabbatical outcomes.

Prior Sabbatical:

I was awarded a full-year, half-time (12 credit) Sabbatical Fall 1996 – Spring 1997. Official award information on the sabbatical is attached for reference, and listing of all sabbaticals is located on the O Drive – Provost – Sabbaticals.

The sabbatical occurred when the department was undergoing immense change, and I remained a program chair and taught half time. The department was teaching out some engineering technology degree programs, starting new engineering programs, and offered of a special engineering completion degree for alumni via distance education.

The sabbatical focused on professional and laboratory development. I had recently received NSF Grants, and the sabbatical activities involved integrating new equipment and developing new learning experiences that were made possible by those grants while paving the way for new grant applications.

I did personal, professional development in the area data acquisition and digital signal processing, and later taught a class in that area for alumni as well as one for industry engineers. That experience helped prepare me for a later experience when I would develop what is now the EE280 Introductory Signal Processing.

I also did volunteer service for NSF and traveled to Washington, DC to participate in grant reviews. In addition I became active in the Instrumentation Society (ISA) at the national level. I became the director of a major division (2,000 members) within that organization, and traveled frequently to planning meetings and helped organize and run conferences in Canada and the US.

Position to complete Sabbatical:

I have been doing professional consulting on an intermittent basis in the area of dynamometer and hardware-in-the-loop testing and validation for hybrid and electric vehicle development. It has been an educational and invigorating experience. This experience has enabled me to learn

new software and hardware, work on engineering development teams with MS and PhD engineers who have vast experience in the field, and work on hybrid/electric vehicles including boats, off-road vehicles, and cars. When I first started I worked on a two-man team. It is now a 12-engineer team, and two of them are LSSU graduates whom I have had in class.

As a by-product of this experience I have taught special topics classes, developed a new course, EGEE 365 Vehicle Instrumentation, and am scheduled to teach a new special topics class EGEE 400 Electric Vehicle Systems during Spring 2011. I have also met many people in industry, and will be able to obtain valuable input into developing new learning experiences for my LSSU students. The field work also helped me see the need for additional course work to prepare young engineers for the changing world of electric motors, motor controls and hybrid/electric vehicles, and I have recently written papers in these areas.

Engineering and Technical Education for Electric Vehicle Development, ASEE Annual Conference, 2010.
http://soa.asee.org/paper/conference/paper-view.cfm?id=23321

Data Acquisition in a Vehicle Instrumentation Course, ASEE Annual Conference, 2010.
http://soa.asee.org/paper/conference/paper-view.cfm?id=23575

Work in Progress: Introductory LabVIEW Real Time Data Acquisition Laboratory Activities, ASEE North Central Section Conference, 2010.
http://www.asee-ncsection.org/

Summary:

The sabbatical will enable development of faculty competency and new laboratory instructional activities that will foster the development of new, timely educational experiences for LSSU engineering students in the areas of modern motor control systems and hybrid/electric vehicle technology.

The sabbatical plan includes clear activities that will support measurable project objectives. The planned activities include graduate educational experiences, networking with industry professionals, and development of new learning experiences that will lead to the revision and development of engineering courses.

Prior consulting opportunities have resulted in field experiences that have yielded fruit in the form of new educational opportunities for LSSU students, and will support the completion of the sabbatical activities. Finally, the sabbatical will foster networking with industrial and educational professionals in the content area.

Attachments:

1. Statement to Agree To Return
2. Prior Sabbatical Award Letters
3. Prior Sabbatical Change of Status Form
4. Recent NSF Proposal Cover Sheet (not funded)
5. NSF Proposal Summary
6. Resume David McDonald (Two Page)

Statement Agreeing To Return

If I am awarded a sabbatical, I agree to return to LSSU for a minimum of one full academic year.

Sincerely

David McDonald
November 13, 2010

Lake Superior State University

Executive Vice President
and Provost

April 12, 1996

Prof. David McDonald
[redacted]

Dear Prof. McDonald:

The Lake Superior State University Sabbatical Committee met on April 5, 1996. I am pleased to inform you that they have recommended that you be awarded Sabbatical leave for one full year half-time. I concur and will forward their recommendation to the Board of Trustees for their approval at the May meeting.

I am pleased for you and have confidence that the time you spend on your sabbatical will be of much value to the University and its students. Congratulations again.

Sincerely,

David L. Toppen
Executive Vice President & Provost

DLT:jas

C: Prof. Ray Adams, Dean

Sault Sainte Marie, Michigan 49783 (906) 635-2211

LAKE SUPERIOR STATE UNIVERSITY

Change of Status

Name David McDonald	Effective Date: September 1, 1996	
	Present Status	Change to
Rank, Title or Position	Electrical Engineering Technology Professor/Chair	Sabbatical Leave Academic year half-time
Term of Appointment	Academic Year	Academic Year
Department and Teaching Assignment	Electrical Engineering Technology	Electrical Engineering Technology
Tenure Status	Tenured	Tenured
Salary	$51,168	To be determined

I. Education:

BSEE Michigan Technological University, 1969

MSEE Michigan Technological University, 1971

Registered Professional Engineer in Michigan

II. Employment History:

1973	Instructor, Lake Superior State University
1980	Assistant Professor, Lake Superior State University
1986	Associate Professor, Lake Superior State University
1995	Professor

III. Rationale for Change:

Professor McDonald is proposing a leave of twelve contract hours for the 1996-97 academic year to undertake professional development that will support instructional activities at LSSU. The objectives of this leave will include professional development in the general area of communication systems and the acquisition of skills in the development and use of multimedia instructional materials.

Major changes have taken place during the last several years of Professor McDonald's teaching area. These include the conversion of the Electrical Engineering Technology Program to the Electrical Engineering Program and the addition of the Telecommunications Engineering Technology Program. Also, as a result of two large National Science Foundation grants, several electrical laboratories have experienced major equipment changes. Additional laboratory development and equipment acquisitions are needed. Professor McDonald's planned sabbatical includes professional development in electrical engineering and telecommunications. His full time teaching load, along with chair duties, do not permit him to devote the necessary time for this professional development.

This sabbatical request will result in improving engineering education for students at LSSU. The sabbatical could enhance the University's chances of obtaining other NSF grants in the areas of the sabbatical.

Professor McDonald's application has been reviewed and approved by the Sabbatical Review Committee.

Recommended By	Title	Date
David L Tarnacki	Executive Vice President and Provost	4/19/96
Robert Ashenhurst	President	4/19/96

LSSU 265-789

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/If not in response to a program announcement/solicitation enter NSF 10-1

NSF 10-544 05/26/10

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

1043476

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

DUE - TUES-Type 1 Project

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
05/25/2010	1	11040000 DUE	7513	074787789	09/22/2010 11:40am S

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

381880022

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Lake Superior State University

AWARDEE ORGANIZATION CODE (IF KNOWN)

0022939000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Lake Superior State University
650 West Easterday Ave.
Sault Ste. Marie, MI. 497831656

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL
☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS THEN CHECK HERE

TITLE OF PROPOSED PROJECT Control and Integration of Electrical Motors for Electric Vehicle and Industrial Applications

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 70,234	24 months	12/01/10	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ EAGER* (GPG II.D.2) ☐ RAPID** (GPG II.D.1)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT
Department of Electrical Engineering

PI/PD FAX NUMBER
906-635-6663

PI/PD POSTAL ADDRESS
650 West Easterday Avenue
Sault Sainte Marie, MI 49783
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME David M McDonald	M.S.	1971	906-635-2208	dmcdonald@gw.lssu.edu
CO-PI/PD Ronald DeLap	DEng	1994	906-635-2272	rdelap@lssu.edu
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

Electronic Signature

Control and Integration of Electrical Motors
for Electric Vehicle and Industrial Applications

Project Summary

The imminent mass production of electric vehicles and implementation of the Smart Grid distribution system coupled with the outsourcing of electric motor manufacturing have changed the emphasis of electrical motor instruction. The need in industry has shifted to the application of this technology, and engineering education instruction is now focused on the integration of modern, high efficiency electric motors and their embedded software controllers.

This project will develop learning experiences in the control and integration of modern high efficiency motors and their motor controller units that are in demand in many electric vehicle and industrial applications. The students will complete instructional activities in the programming of the motor controllers using the model-based design process for embedded software development and Hardware In the Loop (HIL) model validation that is commonly used in industry today.

Recent engineering education research reports that many current engineering students see little correlation between their current studies and their role as an engineer. Graduates report that design activities are more complex in industry because of the need to coordinate with other areas. Therefore the instructional pedagogy of the project embraces project-based experiences that most closely approximate the industrial environment. This approach is believed to help prepare students for design experiences in industry as well as preparing students to manage the supports and barriers that impact their goal achievement in industry.

The project implementation targets upper-level students in undergraduate engineering, but also includes activities that focus on freshmen engineering as well as visiting high school students. The project develops the pilot of a new course on Electric Vehicle Systems that focuses on the vehicle drive train. The project also modifies existing control systems and energy conversion courses to emphasize the integration of electric motors. The instruction adapts activities from similar NSF supported projects that significantly improved student interest and course outcomes.

The project activities will involve senior design teams for the development of the laboratory motor control instructional units to provide cost savings and foster student ownership of the project. The project evaluation will involve a professor at the university who is experienced in grant evaluation. The PI has extensive teaching, laboratory development, and grant experience as well as recent engineering experience in the electric vehicle industry. The CoPI has extensive project management experience and recent automotive engineering industrial experience.

The project will culminate in revised educational experiences that create a learning environment that most closely approximates industry, provides economy of shared resources, and serves as a model for smaller schools that need to enhance electric motor control instruction.

Summary of Grant Review

Statistics: 1181 grants received, 1160 eligible for review, 130 awards made

New Proposals Due: May 26, 2011

Comments below are condensed from Panel Summary. Bold on the first constructive bullet below is my addition because this seemed to be a significant point for the reviewers.

Concerns about resubmitting the proposal are that there was only an 11% award rate and the reviewers felt at least part of the proposal should be solely the responsibility of the university to support and maintain courses with changes in technology. The proposal would need major revisions before resubmission.

Supportive:

- Panel felt the new course addresses a new technology of interest to students that builds on an existing knowledge base.
- The project will have impact across a number of courses at the home university.
- The PI is well-qualified for the work with prior NSF-experience and relevant coursework.
- Sufficient resources and time are devoted to the project, and the budget is reasonable.
- The evaluation plan is good in general, particularly with the use of an independent evaluator.

Constructive:

- **A fundamental question exists as to whether or not this project is a routine part of being a faculty member. If it is, then it does not align with the expectations of the TUES program.**
- Desire to see more discussion of the details of applying problem based learning within the course.
- Need for more details on how other institutions can adapt the course model and a stronger dissemination plan in general.
- While the project seems to be adaptable, suggestions about how the project can be adapted are absent in the proposal. Dissemination is an important aspect of the successful TUES proposal and this proposal could be strengthened with a stronger dissemination plan.
- Need for a clear objective for the course and stronger link to electric motors.

David M McDonald

School of Engineering and Technology
Lake Superior State University
Sault Ste. Marie, MI 49783

Tel: 906-635-2207
Fax: 906-635-6663
email: dmcdonald@lssu.edu

Degrees:
B.S. in Electrical Engineering, Michigan Technological University, 1969
M.S. in Electrical Engineering, Michigan Technological University, 1971

Number of years service on this faculty: 37
Instructor(73'), Assistant Prof. (80'), Associate (86'), Professor (95')
Previous Chair, General Engineering and Engineering Technology (1996-2004)
Previous Chair, Electrical Engineering Technology (1984 – 1996)
Faculty, Department of Electrical and Computer Engineering (1996-present)

Courses Taught (Last 10 years):
Taught undergraduate lecture classes and developed laboratory activities in several areas of Electrical Engineering: Electro-Mechanical Systems (DC/AC Motors), Introductory DSP, Feedback Control Systems, Circuit & Network Analysis, Signals and Systems, Analog & Digital Fundamentals, Senior Design, Linear Algebra/MATLAB, Statistics, LabVIEW data acquisition, Vehicle Instrumentation - CAN bus data acquisition and simulation.

Industrial Experience: Consulting Contract Engineer
Magna E-Car Systems, Rochester Hills, MI. October 2008 – Present:
Development of test cell dynamometer and HIL applications for battery electric vehicle motor development. LabVIEW Real Time programming for dynamometer control and instrumentation.

Bluwav Systems, Rochester Hills, MI., August 2007- October 2008.
Development of DC motor and chassis dynos and test systems for battery electric/hybrid vehicles. Maintained and upgraded dynamometer systems for motor testing; LabVIEW programming; Commissioning of 300Hp motor dyno test cell; Developed test procedures and reports.

WaveCrestLabs, Rochester Hills, MI, May, 2006 – August, 2007.
Start-up of motor dynamometers for electric/hybrid vehicle motor development.
Programming for dynamometer applications; Data acquisition, Dyno motor drives, CAN bus, Battery Simulators, Power Meters, Developed test scripts, operator manuals and documentation.

Co-Directed & taught engineering summer camps: Summer Institute for Technology (1993 -2004), Women in Technology and Robotics Camp (1997-2004).
Training: Taught data acquisition & LabVIEW to General Motors staff (summer 97'-98')
Electrical Engineer: industrial & Automotive Electronics, Chrysler Corporation, 1971-1973

Professional Affiliations and Service
ASEE: Professional Member, Campus Representative, NC Section Executive Board Member
IEEE: Senior Member, Served on EET on-site program accreditation teams.
SAE: Member, participate in World Congress and section activities.
ISA: Past ISA member and Past Director of 2,000 member Management Division

Grant Experience: Director or Co-Director

National Science Foundation

2001 NSF-CCLI Integrated Energy Conversion Laboratory development - PI
2002 NSF-CSEM LSSU CSEM Scholars Program -PI
2000 Consumers Energy, Development of Energy Conversion Laboratory - PI
1997 NSF-ILI Project to develop a new integrated systems engineering laboratory -PI
1994 NSF-ILI Project to update several labs with computer-based instrumentation -PI
1993 NSF-ILI Project that improved instruction in data acquisition and mirco-controllers -PI
1993 NSF-CCD Project to develop an innovative Exploring Technology freshman course -PI

Michigan Department of Education (93 – 04)

Summer Institute for Technology: engineering camps-gifted & talented high school students.

Recent Papers

McDonald, Introductory LabVIEW Real Time Laboratory Activities, ASEE NC Sect Conf 2010
McDonald, Data Acquisition in a Vehicle Instrumentation Course, AC 2010
McDonald, Engineering and Technical Education for Electric Vehicle Dev. ASEE AC 2010
McDonald, Hildebrand, Laboratory Learning ExperiencesVehicle Engr. SAE 2010 WC
McDonald Confidential Industrial Report on Electric Motor Testing, Magna IPS 2009
McDonald, Simulation Learning Experiences in Energy Conversion with Simulink and SimPowerSystems, ASEE Annual Conference, 2006, Chicago
Duesing, McDonald, Schmaltz Qualitative and Quantitative Assessment to Accomplish Continuous Improvement, National Assessment Institute Conference, Oct, 2005.
Duesing, Baumann, McDonald, Walworth, Andersen, Learning and Practicing The Design Review Process In Senior Capstone Design Classes, ASEE Annual Conf, 2004
Duesing, McDonald, Laboratory Development in Power Generation, Conversion and Dissipation, ASEE NC Section Conference, 2004

Other Sample Papers

McDonald, Applications of MathCAD in Network Analysis Instruction, Journal of Computers in Education, ASEE, 1996. Reprint – *Received 2nd place award* by Computers in Education Division at 1995 Annual conference.
Mahajan and McDonald, An Innovative Digital Signal Processing Laboratory Experience, Journal of Computers in Education, ASEE, 1998.
McDonald, Mahajan, A Hands-On Survey-Of-Technology Course for Pre Technology Majors, ASEE NSC Conference, 1996. *Awarded the Second Best Conference Paper.*
Pardini, Piero, and McDonald, Automazione La Formazione Vitruale. Collaborative Italian magazine artice on the use of Lab VIEW virtual instrumentation in education, 1999.

Recent Industrial Professional Development (2005 – Present)

CAN bus: Vector CAN, CANalyzer, CANoe, CAPL – bus analysis, simulation, programming LSSU
Audited CS and robotics & automation software courses.
Advanced MATLAB courses: Adv. MATLAB, Data Acq & Instrument Control, Data Processing & Visualization, and Signal Processing
Simulink courses: Simulink, Advanced Simulink, S-functions, Stateflow, Real Time, Real Time Embedded Coder, Model-Based Design
National Instruments: LabVIEW training courses: LabVIEW Intermediate Successful Development & Connectivity, Data Acquisition, Real Time & FPGA courses
Texas Instruments: Introductory Real Time DSP for Educators.

Electric Motor Control Technology
For Industrial and Electric/Hybrid Vehicle Applications

Fall 2011 – Spring 2012

Overview:

I am very thankful for the sabbatical opportunity. It was a tremendous, successful experience. I want to express my deep appreciation and gratitude to my wife and family for their endless encouragement and support, the LSSU Sabbatical Committee for supporting my application, and the faculty and staff of the School of Engineering and Technology who supported me by covering additional classes and other activities when I was gone.

I left LSSU and Sault Ste Marie on May 2, 2011 and returned on August 20, 2012. During those sixteen months I never left the Detroit Metro area. It was a unique experience to attend night classes at the University of Detroit Mercy and Oakland University, to work on class project teams with engineers from industry, and participate in classes with traditional graduate students.

The original sabbatical goal is shown below. I am satisfied that the intent and spirit of the goal were achieved during the sabbatical.

Sabbatical Goal:

The sabbatical will enable development of faculty competency and new laboratory instructional activities that will help prepare students for employment and graduate school in the areas of electric vehicle engineering, modern motor integration development, and/or hardware/software-in-the-loop technology for embedded motor control validation.

Sabbatical Activities:

The Sabbatical Activities included a combination of exposure to new technology, networking with like-minded educational and industrial professionals, and related professional meetings, conferences and tours. In additional I participated in informal educational experiences and formal graduate courses. Specific activities include the following:

Summer – Fall 2011:

1. Attended the 3-E Conference on electric/hybrid vehicle education. The speakers represented many community colleges and universities, and described recent developments in hybrid/electric vehicle educational opportunities that they were developing. The topics covered technical training and both undergraduate and graduate courses and degree programs.

2. Toured the plant where the Chevrolet Volt is assembled and watched as the battery and other components were installed. The tour included a presentation on the operation of the Volt and an opportunity to ask questions of engineers who worked with the vehicle.

3. Developed a motor controller for a PC-based system using LabVIEW, and then upgraded the system using LabVIEW Real Time to control the system in real time and interface with encoders, resolvers and CAN.

4. Attended multiple engineering presentations on battery systems, electric motors, and controllers by engineering professionals who were developing battery, control, and motor systems for electric and hybrid vehicle applications.

5. Completed the course AEV5010 Introduction to Advanced Electric Vehicles at the University of Detroit Mercy. This course is part of the new Advanced Electric Vehicle Graduate Program at UDM. There were both industry professional engineers and traditional graduate students taking the course. I worked on a three man team with an Electrical Engineer from Lansing and a Mechanical Engineer who worked for General Motors.

Winter-Spring 2012:

6. Audited three graduate level Electrical Engineering courses at Oakland University: ECE 570 Microprocessor Based System Design, ECE571 Mixed Signal Embedded Systems, and ECE572 Microcomputer Based Control Systems.

7. Became familiar with the National Instruments Real-Time software VeriStand that is used for Real Time Controllers for instrumentation and control. VeriStand can be used for Hardware-In-The-Loop (HIL) applications for Verification and Validation, and would be useful to support a HIL laboratory activity at LSSU. I also used LabVIEW to create Custom Applications for VeriStand.

8. Worked with the National Instruments Single-Board RIO Controller and LabVIEW Real Time and FPGA software. Developed a paper on LabVIEW FPGA and Real Time Programming for use at a future ASEE Conference.

9. Participated in professional-level, advanced LabVIEW Real Time programming instruction that was sponsored by National Instruments.

10. Attended multiple presentations on battery systems, electric motor controls, and fuel-cell system controllers by engineering professionals who were developing various systems for electric and fuel cell based vehicle applications.

11. Studied vehicle controller interface software CCP/XCP for CAN and the use of the Vector-based CANAPE and NI-based LabVIEW ECU Toolbox software. CAN Calibration Protocol (CCP) and Extended CAN Calibration Protocol (XCP) for CAN and Ethernet are used extensively in vehicle systems to calibrate power electronics for electric motor controls. XCP and CCP are frequently used to calibrate and/or acquire data from embedded vehicle Electronic Control Units (ECUs).

12. Developed the paper: "Electric Vehicle Drive Simulation with MATLAB/Simulink", *http://people.cst.cmich.edu/yelam1k/asee/ASEE_North_Central_Section/Events_files/Full%20Papers/McDonald.pdf*. I have received requests for additional information on this paper from graduate students in the US and beyond, other engineering professors, and a research engineer at Ford.

13. Attended the SAE World Congress in Detroit and presented the paper "Applications of CAN Instrumentation in Vehicle Systems Engineering Education with CANoe and MATLAB/Simulink."

Conclusion:

I am very thankful for the sabbatical opportunity and the many individuals who encouraged and helped me. I am also thankful for the support I received when I returned to LSSU, and for my students who helped me realize again how much I love teaching.