



Capabilities

Communicating the Science of Prosthetics and Orthotics

NORTHWESTERN
UNIVERSITY

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Farmers/Ranchers with Amputation Are Focus of NURERC Study

The Northwestern University Rehabilitation Engineering Research Center (NURERC), funded by NIDRR (Grant H133E080009), will collaborate with the National AgrAbility Project located at Purdue University, to conduct a study about the durability of prosthetic components used by agricultural workers. The title of the study is "Assessing and Responding to the Prosthetic Needs of Farmers and Ranchers." The purpose of this study is to improve the prosthetic devices used by farmers and ranchers.

During data collection, NURERC researchers will interview farmers and ranchers regarding their prosthetic components and how and when these components fail. Researchers encourage prosthesis users and prosthetists to submit photographs or loan us their broken prostheses and prosthetic components. Researchers will photograph and return all loaned prosthetic items.

FARMERS WITH AMPUTATION WE NEED YOU!

Are you a farmer or rancher with an amputation? Do you farm or ranch using a prosthesis? Does your artificial arm or leg break? How and when does it break? Talk with us! Your experience can help other amputee farmers and ranchers.

NURERC is interested in speaking with you if you work on your farm or ranch using upper or lower limb prostheses. If you are a farmer or rancher who works using one or more prostheses, we invite you to **participate in the NURERC-AgrAbility study**.

Share your experience and help other farmers and ranchers work after limb loss. We encourage you to submit broken prostheses, prosthetic parts, or their photographs to researchers.

Please take part in this NURERC study.

Email: Kathy Waldera
(k-waldera@northwestern.edu)
Call 312-238-6506

PROSTHETISTS WE NEED YOU!

Do you serve clients who are farmers or ranchers with an amputation? Do their prostheses break? How and when do they break? Talk with us! Your experience can help us develop a data base about the durability of prostheses and prosthetic components.

NURERC is interested in speaking with prosthetists whose clients are farmers and ranchers who work using upper or lower limb prostheses. We invite you to **participate in the NURERC-AgrAbility study**.

Share your professional experience and help other prosthetists enable farmers and ranchers to work after limb loss. We encourage you to submit broken prostheses, prosthetic parts, or their photographs to researchers.

If your clients work on farms or ranches using prostheses, please direct them to this NURERC study.

Email: Kathy Waldera
(k-waldera@northwestern.edu)
Call 312-238-6506

Funding Renewal at NURERC Promotes New Direction, Preserves Continuity

“The vision for our Rehabilitation Engineering Research Center (RERC) is to improve the quality of life for persons who use prostheses and orthoses through creative applications of science and engineering to prosthetics and orthotics (P&O)...The goal of our research efforts is to increase understanding about the fundamental biomechanics of standing, walking, reaching, grasping and the corresponding utilization of P&O devices for these activities that will better enable us to evaluate and improve upon current P&O technologies.”

From **Abstract**
National Institute on Disability and Rehabilitation Research
Rehabilitation Engineering Research Center for Prosthetics and Orthotics

The **Northwestern University Rehabilitation Engineering Research Center (NURERC) for Prosthetics and Orthotics (P&O)** has entered a new 5-year funding cycle with renewal of RERC funding from the **National Institute on Disability and Rehabilitation Research (NIDRR)**. This issue of *Capabilities* highlights two facets, one new and the other ongoing, of our NIDRR mission as an RERC. A new project, “Assessing and Responding to the Prosthetic Needs of Farmers and Ranchers”, seeks to improve the durability of prostheses used in farming and ranching. An ongoing component of our mission as an RERC is to disseminate knowledge about rehabilitation engineering and the research and development of P&O.

NURERC Seeks Durable Prostheses for Farmers and Ranchers

NURERC, in collaboration with the **National AgrAbility Project (NAP)**, is developing a data base about the use, durability and improvement of prosthetic devices used in farming and ranching. Farming is America’s most hazardous occupation. Annually, approximately 800,000 US farmers sustain serious injury, some of which result in amputation. **NAP** helps farmers with a disability to maintain self-sufficiency in their occupation. NURERC is recruiting farmers, ranchers and their prosthetists to collect information that can improve the robustness of prostheses. Robust prostheses can help farmers resume farming and self-sufficiency after a disabling injury. **Brenda Besse’s** story demonstrates farming success despite a potentially devastating disability.

Educational Outreach about Rehabilitation Engineering in P&O

An important NURERC priority as defined by NIDRR is “to disseminate research results to persons with disabilities, their representatives, disability organizations, service providers, professional journals, manufacturers and other interested parties.” Quarterly publications of *Capabilities*, which are free of charge, disseminate knowledge about rehabilitation engineering in P&O to all who are interested. Other forms of NURERC dissemination include Laboratory Tours, the NURERC website, presentations, posters, publications, and participation in professional organizations. These educational activities stimulate interest in rehabilitation engineering in P&O, promote the exchange of information, and create opportunities for potential collaboration.

This issue of *Capabilities* underscores the Laboratory Tour as a fundamental component of NURERC’s dissemination activities about rehabilitation engineering research in P&O. Faculty and graduate students frequently conduct informative tours of the laboratory and explain P&O projects. This quarter, NURERC welcomed international visitors from Vietnam, France, Germany, Austria, Japan and Scotland. Representatives visited from universities such as **Harvard-MIT** and **University of Strathclyde**; corporations such as **Otto-Bock HealthCare**; organizations such as **Handicap International**, **AgrAbility**, and the **American Orthotics Prosthetics Association**; and government agencies such as the **Department of Veterans Affairs**.

Please enjoy this issue of *Capabilities* and learn how NURERC works to improve the lives of those living with a disability.

~**R. J. Garrick, Ph.D.**~
Capabilities, Editor

AgrAbility Project Enables Farmers with a Disability and Improves Farm Safety

R. J. Garrick, Ph.D.

Farming is the USA's most dangerous occupation with 28 deaths per 100,000, more dangerous than mining and construction. According to the **National Farm Safety Council (NFSC)** statistics released during **National Farm Safety and Health Week (September 21-27, 2008)** in 2007 the USA had about 1,750,000 full-time agricultural workers, of whom 715 farmers and ranchers died in farm accidents. The majority of farm deaths involved tractors. Another 80,000 farm workers suffered disabling accidents, many of which were amputations. Sixty percent of farm injuries result from working with livestock, while other injuries occur during crop production. Many farmers and ranchers continue to work despite physical disability.

The farm is both workplace and home for farmers and their families, exposing them to the ever-present hazards of livestock, machinery, electric current, poisons, firearms, explosions, grain storage, open pits and water, as well as toxic and carcinogenic substances. In addition to traumatic injury, farm workers and their families are at risk for pulmonary disease, arthritis, hearing loss and blindness. Children and youth are particularly at risk for injury.

In an effort to prevent injuries and fatalities on US farms and ranches, in 1944 Franklin D. Roosevelt proclaimed the first annual **National Farm Safety Week**. Since then, government and private agencies have developed programs that educate farmers in the prevention of occupational injuries and diseases and assist farmers who work with a disability.

Breaking New Ground (BNG) is an organization that grew from a grass-roots effort by **William Field, Ed.D.**, Professor and current Project Leader of the National AgrAbility Project at Purdue University. In 1979, after helping a man with paraplegia return to farming, Dr. Field founded

BNG to promote independence among farmers working despite a disability. In 1990 **Easter Seals** championed the **National AgrAbility Project (NAP)** that was funded by the United States Department of Agriculture (USDA). On June 18, 2008 Congress reauthorized the **Farm Bill** with another eight years of funding for NAP. During the current funding cycle, the NAP will be administered jointly by **Purdue University** (West Lafayette, IN), the **Goodwill Industries International, Inc.** (Washington, D.C.) and the **Arthritis Foundation/Indiana Chapter** (Indianapolis, IN).

NAP focuses on the needs of persons with disabilities who are employed in agriculture and promotes farm safety throughout the 50 states. **State and Regional AgrAbility Projects (SRAPs)** conduct outreach and maintain affiliations with university extensions, Goodwill Industries, centers for independent living, occupational therapy centers, and other specialists. The Illinois affiliate is headed by **Robert Aherin, Ph.D.**, Department of Agricultural Engineering at the University of Illinois, Urbana, IL.

NAP's annual **National AgrAbility Workshop** will be held in Wichita, KS, from November 10 through 13, 2008. Programs will offer technical assistance and resources to farmers, ranchers and their families. Topics include trends in disability and rehabilitation; assistive technology for agricultural settings; service strategies for farmers with disabilities; and information about AgrAbility projects. As part of the collaborative NURERC-AgrAbility project, NURERC's **Kathy Waldera, M.S.**, and **Craig Heckathorne, M.Sc.**, Research Engineers, will present "**Options in Upper and Lower Limb Prosthetics: Where Are We and What Needs To Be Done?**" Also, they will discuss device failure with farmers who use a prosthesis.

Internet Resources Offer Information about Farm Safety and Farming with a Disability

- ◆ **National AgrAbility Project:** www.agrability.org
- ◆ **Illinois AgrAbility:** www.agrabilityunlimited.org
- ◆ **Breaking New Ground (BNG):** <http://cobweb.ecn.purdue.edu/~bng/BNG/Resource%20Center/resourcecenter.html>
- ◆ **Rural Caregivers:** www.ruralcare.info
- ◆ **National Institute for Occupational Safety and Health (NIOSH):** <http://www.cdc.gov/niosh/topics/agriculture>
- ◆ **National Safety Council:** <http://www.nsc.org/resources/issues/agrisafe.aspx>
- ◆ **Progressive Agriculture Foundation:** <http://www.progressiveag.org>
- ◆ **American Society of Agricultural and Biological Engineers (ASABE) Technical Library's** articles about farmers with disability: <http://asae.frymulti.com/newresults.asp>
- ◆ **National Ag Safety Database:** <http://www.cdc.gov/nasd>

Brenda Besse: Overcoming Adversity

R. J. Garrick, Ph.D.

Brenda Besse is no stranger to meeting adversity head-on. Likewise, she knows hard work and the success that it brings. Enthusiastic and determined, Besse has excelled in many areas, including farming, ranching, golfing, and giving motivational speeches, all while wearing an above-the-knee prosthesis. She reflects, "I think I could do just about anything if I put my mind to it." An energetic activist who assists farmers living with a disability, Besse fills multiple roles, including Partner in Brierwood Farms' national level prize-winning, registered herd of Brown Swiss Cattle; and Partner in Besse Farms, a 3,500 acre grain farm in Whiteside County, IL. She is a Field Representative for AgrAbility Unlimited for Illinois; Midwest Field Representative for **College Park Industries** (Fraser, MI); and a requested speaker at meetings of the **Amputee Coalition of America (ACA)**, **Farm Safety Day Camps**, **Farm Bureau**, **Future Farmers of America**, **4-H**, the **AgrAbility National Convention** and elsewhere. Also, Besse is an avid golfer. She is the USA's number one Amputee Ladies Golfer with 67 wins in 81 outings.



Brenda Besse

Raised on her family's farm near Erie, IL, she learned how to perform the demanding work of managing a major agricultural enterprise. From adolescence, she operated 24-row planters and enormous combines used to plant and harvest. Athletic and energetic, Besse excelled at sports. She was captain and point guard for her high school and college basketball teams and captain of her high school softball team.

After Besse graduated from college, she returned to her family farm where she conducted the daily chores that ensured overall herd health of the family's 100-head Angus cow-calf operation. She enjoyed working hard, but one day Besse's life changed forever. On a farm, things can go wrong in an instant. While clearing corn stalks from the head of a combine, it crept forward. The rollers and gathering chains caught her trousers and relentlessly pulled her leg into the cutter. "I knew immediately this was it, the two minute drill. I'd either survive or die." After her leg was severed, with an indomitable strength and presence of mind, she managed to climb into the cab of the combine and drive to assistance.

She survived the accident, but it was a long process to turn her loss into something positive. "At first I felt bitter and angry because I couldn't work or play sports like I used to. But, your true character is revealed when you come face to

face with adversity." Her parents bought her a set of golf clubs. "My college roommate, **Meg Cavanaugh** (Northbrook, IL), really helped me with my golf game. Golf is what really brought me back."

Besse reflected, "Shortly after the accident, it clicked. Anyone can deal with loss in a positive way." She decided to use her experience to help others who are stricken by a farming accident. Farm accidents often are severe and even deadly. "There is a huge learning curve after any kind of farm accident. At the time of my accident in 1981, I didn't even know how to spell 'prosthesis.'"

Through the years, prostheses have improved, but phantom pain remains a constant presence. "Phantom pain is the worst part of an amputation. It comes and goes like a ghost and bites like a shark," Besse remarked.

In addition to managing her own agricultural enterprises, Besse spends time and energy helping disabled farmers to resume active and productive lives. As Field Representative for **AgrAbility Unlimited for Illinois**, Besse conducts outreach visits to 37 counties in Northern Illinois. She provides agriculturists with information about local programs that can resolve mobility and financial problems and return them to farm work. Farmers with an amputation or other disability benefit from the scope of her personal experience. Besse is a vigorous farmer who is on her feet from dawn to dusk. Using an above-the-knee prosthesis with a hydraulic single-axis knee and a multi-axial foot gives her voice legitimacy and provides hope and inspiration to individuals who may doubt their ability to farm after experiencing an amputation. Besse observed, "This sounds like a cliché, but I can say that I am a better person now than I was before this accident."

In 2005 Besse received the **Governor of Illinois' People Are Today's Heroes (PATH) Award**; the **Volvo for Life Award** in recognition of her contributions to society in the areas of safety, quality of life and the environment; and the **Volunteer of the Year Award** for the **Amputee Coalition of America (ACA)**. Brenda Besse also is an expert fundraiser who has lead successful campaigns for the **United Way**, the **Rehabilitation Institute of Chicago (RIC)**, **AgrAbility** and other organizations that improve the lives of those living with a disability.

◆ Illinois farmers and ranchers are invited to contact AgrAbility Unlimited by calling 800-500-7325 and visit the AgrAbility Unlimited website: www.agrabilityunlimited.org.

NIDRR Grant Funds 5-year RERC for P&O at NUPRL-RERP

R. J. Garrick, Ph.D.

The **National Institute on Disability and Rehabilitation Research (NIDRR)** of the **United States Department of Education** has awarded the **Northwestern Prosthetics Research Laboratory (NUPRL)** and **Rehabilitation Engineering Research Program (RERP)** a five year grant as a **Rehabilitation Engineering Research Center (RERC) for Prosthetics and Orthotics (P&O)** under NIDRR Grant H133E080009.

NUPRL-RERP evolved from a laboratory that was founded by orthopedist **Clifton Compere, M.D.**, and later directed by **Dudley S. Childress, Ph.D.** In 1972 this Northwestern University laboratory received one of the first national Rehabilitation Engineering Center grants from an entity that was the National Institute on Handicapped Research (NIHR). In 1987 the laboratory focused its research on limb prosthetics and orthotics. Now under the directorship of **Steven A. Gard, Ph.D.**, NUPRL-RERP is honored to have been NIDRR's designated Rehabilitation Engineering Research Center for prosthetics and orthotics for nearly four decades.

NURERC recognizes and appreciates the vital, collaborative relationships between our laboratory and the



NURERC laboratory members are (from left, back) **Andrew Hansen, Joshua Rolock, Edward Grahn, R. J. Garrick, Steven Gard, Craig Heckathorne, Kerice Tucker**, (from left, front) **Rebecca Stine, Dilip Thacker, Dudley Childress, Kathy Waldera, Stefania Fatone**.

university, organizations, practitioners, and businesses that support our work in rehabilitation engineering. We particularly appreciate invaluable institutional support from the **Northwestern University Department of Biomedical Engineering** in the **McCormick School of Engineering and Applied Science**; the **Department of Physical Medicine and Rehabilitation (PM&R)**

at the **Feinberg School of Medicine**; and the **Rehabilitation Institute of Chicago (RIC)**.

Steven A. Gard, Ph.D., and **Stefania Fatone, Ph.D.**, BPO(Hons), are Co-Principal Investigators of this grant; however, the combined abilities and efforts of the NUPRL and RERP staff and faculty contributed to the success of the grant proposal. Special thanks are due Ms. **Elizabeth Schreiber**, Program Assistant, and Ms. **Rosemary Collard**, Departmental Assistant. As in the past, all laboratory members will continue to work as a team to complete the proposed projects.

During the next five years of this NIDRR grant cycle, NURERC will conduct seven research projects, five development projects, and multiple educational projects that will expand the understanding of the biomechanics of human movement, develop improved devices for people with amputations, and train others in these areas of knowledge.



NURERC graduate students are (from left, back) **Charles Wang, Kiki Zissimopoulos, Erin Boutwell, Sara Koehler, Brian Ruhe**, (from left, front) **Elizabeth Klodd, Po-Fu Su, B. J. Johnson, Lexyne McNealy**. Graduate students **Eric Nickel** and **Pinata Sessoms** are not shown.



Special appreciation for their work preparing the NIDRR proposal go to (left) Ms. **Rosemary Collard**, Departmental Assistant, and (right) Ms. **Elizabeth Schreiber**, Program Assistant.

Thien Nhan: Living in a World Where People Seek to Do Good

R. J. Garrick, Ph.D.

The young life of **Thien Nhan** already encompasses the efforts of many people who seek to do good by transforming his tragic start into a life of love, mobility and education. Abandoned at birth (July 15, 2006) in a central Vietnam field, the newborn boy miraculously survived mauling by a wild animal. A villager discovered the ravaged infant and carried him on a motorbike for two and a half hours over rough roads to the nearest hospital in Danang. Hemorrhaging, starving and barely alive, the baby boy's right leg and genitals had been devoured. Doctors amputated the remains of his right leg and managed to save the baby's life. Monks who visited the baby named him **Thien Nhan** which in Vietnamese means "person who seeks to do good." Local police investigated and located the parents of the hapless teenager who had given birth to the boy and later left the village. Discharged from the hospital after two months, Thien Nhan was returned to his grandparents despite their extreme poverty and reluctance to care for him.

Thien Nhan's story became national news throughout Vietnam, attracting the attention of journalists and ordinary citizens, but soon it was forgotten by all but a few. **Mai Anh Tran**, a Hanoi journalist with two sons of her own, continued to worry about the tiny boy's plight. She located him in December 2007. Neglected and filthy, he lived on the dirt floor of his grandparents' hut. Alarmed by his acute diarrhea, malnutrition and anemia, Mai Anh took him to an urgent care medical center. In March 2008, Mai Anh and her husband, **Quang Nghinh Phung**, also a journalist, adopted Thien Nhan and vowed to help him obtain the surgeries, prostheses and rehabilitation necessary for him to live normally. During the next 15 years, Thien Nhan will require a series of complex reconstructive surgeries of his uro-genital system, hormonal therapy, as well as a series of prosthetic legs that can meet the scope of his growth and activity.

Impossible goals to achieve alone, the family's efforts have met with an outpouring of generosity and support. The Seattle-based nonprofit organization, **Kids Without Borders (KWB)**, hosts a fund for Thien Nhan's reconstructive surgeries and rehabilitation. **Greig Craft** and **Hoang Thi Na Huong** of the **Asia Injury Prevention Foundation (AIPF)**



Thien Nhan with his mother Mai Anh Tran and his father Quang Nghinh Phung.

organized Thien Nhan's medical care in the United States, paid their own travel expenses, and accompanied Thien Nhan and his family throughout the medical trip.

At **Dartmouth-Hitchcock Medical Center (DHMC)** in New Hampshire, **Daniel Herz**, M.D., performed a urethral dilation that enabled Thien Nhan to retain continence and urinate without obstruction or pain. The family met with plastic surgeon **Joseph Rosen**, M.D., of DHMC who may lead a surgical team for Thien Nhan's future genital reconstruction.

In Chicago, **Dudley S. Childress**, Ph.D., Director Emeritus of **NUPRL-RERP**, arranged for Thien Nhan's prosthetic evaluation at the **Pediatric and Adolescent Rehabilitation Services** at the **Rehabilitation**

Institute of Chicago (RIC). **Dudley Childress**, Ph.D., **Deborah Gaebler-Spira**, M.D., Director, Cerebral Palsy Program and Professor of Pediatrics and Physical Medicine & Rehabilitation at RIC, **Nicole Soltys**, CP, and others on the RIC pediatric rehabilitation team discussed prostheses and pediatric walkers that could enhance his mobility. For stability, he will continue to use a prosthetic leg without joints until his gait matures. For this level of amputation, prosthetists may add a hip joint to the prosthesis when he is about four and a knee joint when he is five years old. As Thien Nhan grows, he must be fitted for a new prosthetic leg approximately every 3 months.

In September Thien Nhan began attending a Hanoi preschool where he is learning new ideas and making new friends. At two years old, he is bright, articulate and socially interactive. See Thien Nhan's progress at <http://help-thien-nhan.blogspot.com>. Although Thien Nhan faces many years of surgeries and prosthetic modifications, his parents and many other good people are helping him learn, grow and live a normal life.

◆ Follow Thien Nhan's progress at <http://help-thien-nhan.blogspot.com>.

◆ Learn more about KWB outreach activities at www.kidswithnoborders.org and traffic safety programs at AIPF at www.wear-a-helmet.com.

Julien Pasquier, Technical Advisor to Handicap International

Julien Pasquier, M.Sc., visited NURERC as a representative of Research and Development in Orthopaedic Technology for the Health and Rehabilitation Unit of **Handicap International (HI)** (Lyon, France). During the week of August 4 through 8, **Andrew Hansen**, Ph.D., and others instructed Mr. Pasquier on the fabrication of the **Shape&Roll Prosthetic Foot (S&RPF)**. Researchers interspersed workbench sessions with discussions about prosthetic function, cosmesis, motion analysis, fatigue testing, quality control, dissemination, as well as field accessibility of materials and technology.



Julien Pasquier, M.Sc.

During his practicum, Mr. Pasquier set up a cement mold for foot production. Using manual lever compression, he molded a S&RPF core, which he marked and trimmed. He completed a three-part mold and created a polyurethane rubber foot shell. Dr. Hansen

and Mr. Pasquier discussed the merits of using foam (Pelite) or silicone cosmetic covers.

Mr. Pasquier is a technical advisor who evaluates all orthopedic devices that HI uses in developing countries. Each country offers various levels of technology. "We must learn what materials are easily available or need to be imported. Some of the variables we consider in each country are the finances, politics, economics, culture, welfare system, regulations and local conditions.

Passionate about his work, Mr. Pasquier reflected, "It is interesting to work with people from different cultures and backgrounds. We underestimate the ability of people to cope with impairment. One must take care to use a positive point of view and not prejudge people. A key issue is to allow a person to become independent. People with a disability prefer to have help that will allow them to live independently."

Handicap International: Standing Tall

R. J. Garrick, Ph.D.

The words *vivre debout* mean "to live standing upright" and suggest the ability to live independently, without assistance. These ideas are emblematic of the work that **Handicap International (HI)** has conducted in developing countries among persons living with a disability. HI is a non-governmental organization (NGO) that improves the lives of disabled people in the developing and post-conflict world. With sections in France, UK, USA, Germany, Luxembourg, Belgium, Canada and Switzerland, HI partners projects in more than 55 countries. It is founded on a respect for human rights, and its mission is to bridge barriers caused by physical, social, economic and political disabilities. HI has expressed interest in the **Shape&Roll Prosthetic Foot**.

HI began its humanitarian work in 1982 inside refugee camps along the Thai-Cambodia border where the group opened rehabilitation centers, trained local staff to fabricate prostheses, disseminated educational material, introduced new technologies appropriate to local settings, enhanced technology transfer, and ultimately built locally-based partnerships into sustainable, inclusive, locally-run programs. HI partnership with local professional networks helps integrate rehabilitation services into countries' national health and social systems. Using Cambodia as an example, HI projects also emphasize recovery from war through education, alleviation of poverty, inclusion, and independent living for people with a disability.

During the past twenty-five years, HI has achieved a global approach to disability and increased the scope of its activities by building networks of local educators who work with families and community groups. During the 1990s HI worked to improve the circumstances of excluded populations in orphanages and mental institutions, particularly in Romania and the Balkans. In developing countries currently served by HI, the organization continues to address mental health issues and initiates inclusion programs. In 1992 HI founded mine clearance programs in Cambodia and Kurdistan and these efforts helped to establish the **International Campaign to Ban Landmines**. In 1996 HI won the **Nansen Refugee Award** from the UN High Commissioner for Refugees. The following year, as one of the six founding organizations of the International Campaign to Ban Landmines, HI was a co-winner of the 1997 **Nobel Peace Prize**.

Strengthening its partnership with local and international organizations, HI helps develop national policies that enable and protect disabled people. Today, HI conducts world-wide public health programs against crippling diseases, promotes the rights of persons living with a disability, and continues its campaign against landmines and cluster bombs.

Learn more about the work of Handicap International at www.handicap-international.org.

Fraunhofer's Urs Schneider, M.D., Introduces Design Process

R. J. Garrick, Ph.D.

Urs Schneider, M.D., Head of Department, Systems in Motion, **Fraunhofer Technologie-Entwicklungsgruppe** (Stuttgart, Germany) visited NURERC on August 26 and 27 and presented an overview of research projects conducted at Fraunhofer. He introduced a structural matrix for the solution of specific bioengineering design problems. Developed during the 1970s in Japan, Toyota and Mitsubishi used this creative, group process to define customer desires, then prioritize and translate them into engineering targets. In the 1980s Hauser and Clausing (See Hauser and Clausing, Harvard Business Review, May-June, 1988) named the process *Quality Function Deployment (QFD)* and introduced it to the USA. Also known as *Matrix Product Planning*, the process employs a series of evaluative matrices to examine an engineering design problem and generate potential solutions.

As used at Fraunhofer, Dr. Schneider invited everyone in the NURERC laboratory to participate in a one hour workshop, where they responded to a particular design question. To promote creativity and richer solutions, everyone participates, including technicians and administrative assistants.



(From left) **Andrew Hansen, Ph.D.**, discusses prosthetic design with **Urs Schneider, M.D.**

Ground rules during the workshop do not allow members to question, criticize or chatter. Everyone contributes ideas directly to the leader, the only person who is allowed to ask questions. Later in the process, the leader reduces all contributed ideas to a few crucial concepts and then ranks them according to feasibility. Eventually, using a spreadsheet, the researcher identifies the design ideas that can be implemented. Dr. Schneider reported that this process may generate a design solution within three weeks.

Dr. Schneider and **Andrew Hansen, Ph.D.**, led the NURERC group through a creative workshop.

Dr. Schneider announced the ground rules of group interaction, explained the design question, and provided an accompanying illustration. During the first 20 minutes, each person thought freely and wrote their ideas, using a separate sheet of paper for each suggestion. After 20 minutes, each author displayed and explained his/her ideas and drawings, to be transferred later into a structural matrix for prioritization and feasibility.

Participants reported that the group process had the potential to stimulate new ideas and fresh solutions. Doctoral candidate **Brian Ruhe, M.S.**, reflected, "I can see how this process is beneficial, a good creational tool. As a group, we were inexperienced and some people were hesitant, so that held us back. This process could bring new ideas. It was an interesting dichotomy in that you are supposed to be free thinking, but at the same time our participation was highly structured. We need to think how we can implement this tool to move our own ideas forward."

In the future, NURERC may incorporate this process to address other design questions. Doctoral candidate **Sara Koehler, M.S.**, said, "I would like to try it again. I am looking forward to using this process to work on new problems that I've never heard or thought of."

Gary E. Behler, Licensing Associate from Northwestern University Technology Transfer Program, also attended the creative workshop. At the conclusion of the session, Mr. Behler discussed ways that NURERC and Fraunhofer might collaborate in the future.



(From left) **Dudley Childress, Ph.D.**, **Urs Schneider, M.D.**, and **Andrew Hansen, Ph.D.**, discussed mutual research interests in rehabilitation engineering.

NURERC Graduate Students at NU Biomedical Engineering Research Day

R. J. Garrick, Ph.D.

Northwestern University sponsored **Biomedical Engineering Research Day** on September 18, 2008 on the Evanston campus. Twenty BME laboratories were represented by 46 posters, providing new graduate students in BME an overview of research laboratories and their products. The day-long event continued with oral presentations, awards for the best posters, and concluded with a barbecue and social program for all participants.



Liz Klodd, M.S. (left) with Matthew Glucksberg, Ph.D. (right), Professor and Chairperson of Biomedical Engineering at Northwestern University, stand in front of her research poster at BME Research Day.

The seven posters and NURERC graduate students who represented the **Prosthetics Research Laboratory** and **Rehabilitation Engineering Research Program** were: *Study of Residual Limb/Prosthetic Socket Compliance in Transtibial Amputees*

by **Erin Boutwell, M.S.**; *Gait Dynamics of Reciprocating Gait Orthosis Users* by **Brett Johnson, M.S.**; *The Effects of Prosthetic Foot Roll-Over Shape Radius on Gait of Prosthesis Users* by **Elizabeth Klodd, M.S.**; *Shock-Absorbing Prosthesis for Persons with Transfemoral Amputations* by **Sara Koehler, M.S.**; *The Effect of Prosthetic Ankle Motion on Gait in Bilateral Transfemoral Amputees* by **Lexyne McNealy, M.S.**; *Investigations of Standing Balance Efficiency on Level and Sloped Surfaces in Persons with Transfemoral Amputation* by **Brian Ruhe, M.S.**; and *Evaluation of the Design and Function of Stance-Control Orthotic Knee Joints* by **Angelika Zissimopoulos, M.S.**

New Equipment Slated for NURERC

R. J. Garrick, Ph.D.

At NURERC, new machines herald new ways to collect and analyze data about human balance, movement and prosthetic fit. The VA Rehabilitation Research and Development offices have awarded funds to **Andrew Hansen, Ph.D.**, and **Joshua Rolock, Ph.D.**, for the purchase of three new machines.

Andrew Hansen, Ph.D., used his award to purchase a **NeuroCom® Balance Manager® SMART EquiTest® Clinical Research System™** with a static Long Force plate (18-inch by 60-inch), and 8 Channel EMG system that uses surface electrodes. The SMART EquiTest CRS provides the ability to test Limits of Stability (LOS) and to simulate real world disturbances of human balance. Other protocols included in this system are the Sensory Organization Test (SOT), Motor Control Test (MCT), Adaptation Test (ADT), Weight Bearing Squat (WBS), Unilateral Stance (US), and Rhythmic Weight Shift (RWS). The machine allows researchers to collect objective data about sensory, voluntary and reflexive motor functions with respect to human balance performance. (For further information about this machine, see www.onbalance.com).

This equipment will be used as part of Dr. Hansen's ongoing research studies.

Joshua Rolock, Ph.D., used his award to purchase two new machines. The first is a **Stratasys 400mc Rapid Prototyping Machine**, which can be used as a new way to make sockets and liners and to create complex, cosmetic coverings. It allows researchers to try a material before setting up complex fabrication on a milling process. (For further information about this machine, see http://stratasys.com/fdm_products.aspx?id=1192.) The second machine awarded to Dr. Rolock is the **Inspeck DF Three-dimensional Optical Digitizer**, which can digitize complex shapes such as a hand or foot. This digitizer provides a photographic record as well as a computer image that helps researchers visualize shape. (For further information about this machine, see <http://www.inspeck.com/products/3ddf/3ddf.asp>.) These machines will be used as part of Dr. Rolock's ongoing research study "Feasibility of a Zero-Impingement Socket for Lower Limb Prostheses."

NURERC NEWS

Dissemination Activities

The Honorable James B. Peake

The Honorable James B. Peake, M.D., Secretary, Department of Veterans Affairs (VA), visited the Jesse Brown VA Chicago Motion Analysis Research Laboratory on August 27. Steven A. Gard, Ph.D., Director of NURERC, and Dudley S. Childress, Ph.D., Director Emeritus of NURERC, explained the laboratory's use and products to Dr. Peake, who was accompanied by Joanne C. Smith, M.D., MBA, President and CEO of RIC, and W. Zev Rymer, M.D., Ph.D., Director, Machines Assisting Recovery from Stroke Rehabilitation Engineering Research Center (MARS-RERC) and Sensory Motor Performance Program (SMPP).



The Honorable James B. Peake, M.D., Secretary, Department of Veterans Affairs, gave Dudley S. Childress, Ph.D., a commemorative medallion during a recent visit to NURERC.

Motivational Speaker Lloyd Bachrach



Lloyd Bachrach

Lloyd Bachrach, who wears prostheses on both legs, is an inspirational speaker and founder of the educational program, *Yes, You Can! Inc.* (Chicago). He visited NURERC on August 14 to learn about research projects in prosthetics and orthotics that can assist persons living with a disability. Born with phocomelia, a congenital bone deficiency that caused his legs to be unusually small,

Mr. Bachrach competed in intercollegiate gymnastics and later became a gymnastics instructor and coach. He participated in the 1996 USA (Atlanta) Paralympic Sit Volleyball team. He conducts motivational outreach and disability awareness programs where he seeks to inspire people of all ages to pursue their goals with self-confidence and determination. In addition to being a motivational speaker, he serves as a peer counselor for **Families and Amputees in Motion (FAIM)**.

Kengo Ohnishi, Ph.D.

Kengo Ohnishi, Ph.D., Associate Professor, Computer Science and Systems Engineering, Department of System Engineering, Okayama Prefectural University (Japan), visited NURERC on August 18, after attending the Myoelectric Controls Symposium



Kengo Ohnishi, Ph.D.

(New Brunswick, Canada). Dr. Ohnishi was a Visiting Researcher at NURERC in 2005-2006. He discussed his research in human-machine systems with emphasis on myoelectric upper limb prostheses.

Greig Craft, President of AIP

Greig Craft, President of Asia Injury Prevention (AIP) Foundation, and Hoang Thi Na Huong, Deputy General Director of Protec Tropical Helmets, a non-profit project of AIP, visited NURERC from Hanoi (Vietnam) on August 26. Mr. Craft was instrumental in arranging a medical trip for Thien Nhan (see story page 5) and his family. Mr. Craft examined options for lower limb prostheses that may assist Thien Nhan in the future.



Stefania Fatone, Ph.D. (left), explains features of motion analysis facilities to Hoang Thi Na Huong (center) and Greig Craft (right) during their visit to NURERC.

Otto Bock HealthCare Representatives

Stefania Fatone, Ph.D., conducted a tour of NURERC laboratories on September 9 for representatives from Otto Bock HealthCare.



Otto Bock HealthCare representatives (from left) Philipp Kampas, Kevin Kelley and Kimberly Walsh discuss prosthetics research with NURERC's Stefania Fatone, Ph.D., and Craig Heckathorne, M.Sc.

Otto Bock HealthCare representatives were Ms. Kimberly Walsh, Director, Clinical Research (USA); Mr. Kevin Kelley, International Project Coordinator (Vienna); Ms. Milana Mileusnic, Clinical Trials Manager (Vienna); and Mr. Philipp Kampas, Project Leader, Prosthetic Legs (Vienna). W. Zev Rymer, M.D., Ph.D., Director, MARS-RERC and SMPP at RIC, accompanied the Otto Bock group.

Hugh Herr, Ph.D.

Hugh Herr, Ph.D., Associate Director, Media Arts and Sciences; Associate Professor, MIT-Harvard Division of Health Sciences and Technology; Director of the

Biomechanics Group, visited NURERC on September 19, 2008 and discussed ongoing research with **Andrew Hansen**, Ph.D., and **Dudley S. Childress**, Ph.D.

Members of AOPA

NURERC researchers and graduate students attended the **American Orthotic and Prosthetic Association (AOPA) National Assembly** that was held September 10 through 13, 2008 at the Chicago Hyatt Regency. On September 8, **Stefania Fatone**, Ph.D., conducted a tour of NURERC for AOPA attendees **James Rogers**, President, **American Academy of Orthotists and Prosthetists (AAOP)**, and **Mark Muller**, board member of AAOP. On September 11 a group of visiting P&O professionals in attendance at the AOPA Assembly also toured research facilities at NURERC.

RIC Open House

NUPRL-NURERC participated in the **Rehabilitation of Chicago Open House** on September 25. NURERC hosted approximately 60 visitors. Accompanied by **W. Zev Rymer**, M.D., Ph.D., Director of **SMPP** at RIC; **Elliot Roth**, M.D., Chief Academic Officer of RIC; and **Joanne C. Smith**, M.D., CEO of RIC, members of the **RIC Board of Directors**, RIC employees and other distinguished guests toured laboratories on the 13th and 14th floors of the RIC building. **Steven A.**



(From left) **Brian Ruhe**, M.S., and **Rebecca Stine**, M.S., explain the motion analysis system to a group that toured NURERC during the RIC Open House.

Gard, Ph.D., Director of NURERC, welcomed visitors to the laboratory and introduced **Stefania Fatone**, Ph.D., **Brian Ruhe**, M.S., and **Rebecca Stine**, M.S., who explained motion analysis and other instrumentation used in the **Jesse Brown VA Chicago Motion Analysis Research Laboratory**. During the RIC Open House, biomedical engineering graduate students **Erin Boutwell**, M.S., **B. J. Johnson**, M.S., **Liz Klodd**, M.S., and **Sara Koehler**, M.S., presented information about NURERC research projects.

PRESENTATIONS

J. E. Uellendahl and **Craig Heckathorne** presented “Nineteen Year Follow-up of a Bilateral Shoulder Disarticulation (BSD) Amputee” at the **2008 MyoElectric Controls/Powered Prosthetics Symposium** held at the University of New Brunswick in Fredericton (Canada) from August 13 through 15.

Steven A. Gard, Ph.D., was invited to present “Does Quantitative Gait Analysis Provide Useful Information for Prosthetics Research and Development?” at the **17th Annual Meeting of the European Society of Movement Analysis for Adults and Children (ESMAC)** held in Antalya (Turkey) September 8 through 13.

NUPOC Celebrates 50th Anniversary

The Northwestern University Prosthetics-Orthotics Center (NUPOC) celebrated its 50th year training prosthetists and orthotists. NUPOC hosted a reception at the Hyatt Regency Chicago on September 22. It was attended by NUPOC faculty, alumni and colleagues.

NURERC and Strathclyde Researchers Update Progress



Margrit Meier, Ph.D.

Margrit Meier, Ph.D., CPO, Director of Research, **National Centre for Prosthetics and Orthotics, University of Strathclyde**, (Glasgow, Scotland), returned to NURERC on September 25-26. With members of her team, **Jake Duers**, P&O Technician, and **Lynne O’Hare**, Ph.D., postdoctoral fellow, Dr. Meier

discussed ongoing and future collaborative research on the **Shape&Roll Prosthetic Foot** with **Andrew Hansen**, Ph.D., **Kerice Tucker**, Research Engineer, and other members of NURERC.



Discussing a research project that is a collaboration of NURERC and the University of Strathclyde are (left to right) **Lynne O’Hare**, Ph.D., **Jake Duers**, P&O Technician, **Kerice Tucker**, Research Engineer, **Andrew Hansen**, Ph.D., and **Margrit Meier**, Ph.D., CPO.

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Northwestern University

Prosthetics Research Laboratory and

Rehabilitation Engineering Research Program

345 E. Superior Street, Room 1441

Chicago, IL 60611-4496

Phone Help Line: (312) 238-6524

FAX: (312) 238-6510

TTD: (312) 238-6530

E-mail: reiu@northwestern.edu

Web Site: <http://www.medschool.northwestern.edu/depts/repoc>

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E-mail: reiu@northwestern.edu

Phone: (312) 238-6524

FAX: (312) 238-6510

Northwestern University PRL & RERP

345 E. Superior St., Room 1441

Chicago, IL 60611

USA

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Director: Steven A. Gard, Ph.D.

Director Emeritus: Dudley S. Childress, Ph.D.

Editor: R. J. Garrick, Ph.D.

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