COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER: (to be assigned by SBOE)	AMOUNT REQUESTED: $49,989

TITLE OF PROPOSED PROJECT:
A computational method to advance the clinical treatment of bone fractures

SPECIFIC PROJECT FOCUS:
Development of a software framework that automatically measures fracture callus in radiographs.

PROJECT START DATE: July 1, 2012	PROJECT END DATE: June 30, 2013
NAME OF INSTITUTION: Boise State University	DEPARTMENT: Office of Sponsored Programs

ADDRESS: 1910 University Dr., Boise, ID 83725-1135

	E-MAIL ADDRESS:	PI PHONE NUMBER:
	osp@boisestate.edu	(208) 426-2857

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR	Dr. Trevor Lujan	Assistant Professor	
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			

	NAME:	SIGNATURE:
Authorized Organizational Representative	Kimberly Page	

SUMMARY PROPOSAL BUDGET

Name of Institution: Boise State University

Name of Project Director: Dr. Trevor Lujan

A. FACULTY AND STAFF

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Dr. Trevor Lujan Assistant Professor	$75,480/year			1.5	$12,580
% OF TOTAL BUDGET: 25%				**SUBTOTAL:**	$12,580

B. VISITING PROFESSORS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
None					
% OF TOTAL BUDGET:				**SUBTOTAL:**	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
None					
% OF TOTAL BUDGET:				**SUBTOTAL:**	

D. GRADUATE / UNDERGRADUATE STUDENTS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
To Be Hired/Undergraduate Student(s)	$10-$12/hour	12			$26,000
% OF TOTAL BUDGET: 52%				**SUBTOTAL:**	$26,000

E. FRINGE BENEFITS

	Rate of Pay (%)	Salary Base	Dollar Amount Requested
Dr. Trevor Lujan	(33%)	$12,580	$4,149
Undergraduate Student(s)	(6%)	$26,000	$1,560

	SUBTOTAL:	$5,709

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
None	
SUBTOTAL:	

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
					SUBTOTAL:	

H. Participant Support Costs: None

	Dollar Amount Requested
1. Stipends	
2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	
SUBTOTAL:	

I. Other Direct Costs:

	Dollar Amount Requested
1. Materials and Supplies	$1,000
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	$4,200
4. Computer Services	

5. Subcontracts		
6. Other (specify nature & breakdown if over $1000) Software		$500
	SUBTOTAL:	$5,700
J. Total Costs: (Add subtotals, sections A through I)	**TOTAL:**	$49,989
K. Amount Requested:	**TOTAL:**	$49,989
Project Director's Signature: 	Date: 5-8-12	

INSTITUTIONAL AND OTHER SECTOR SUPPORT
(add additional pages as necessary)

A. INSTITUTIONAL / OTHER SECTOR DOLLARS

Source / Description	Amount

B. FACULTY / STAFF POSITIONS

Description

C. CAPITAL EQUIPMENT

Description

D. FACILITIES & INSTRUMENTATION

Description
Institutional support from Boise State University will include contributions from the Northwest Tissue Mechanics Laboratory and the Office of
University and Industry Ventures. The new Northwest Tissue Mechanics laboratory will provide space and computational resources to
complete all aims of the proposal. The office of University and Industry Ventures has agreed to support intellectual property protection of
XReader software. Extramural support will come from St. Luke's Hospital, the University of Iowa and Legacy Emanuel Hospital. These
research centers will provide a large number of radiographic and clinical data to validate the system in milestone 3.

IDAHO PUBLIC INSTITUTION

Boise State University

DIRECTING FACULTY MEMBER

Trevor J. Lujan, Ph.D. Assistant Professor in Mechanical & Biomedical Engineering.

Director of the Northwest Tissue Mechanics Laboratory.

INCUBATION FUND HISTORY FOR THE PROPOSED TECHNOLOGY

This proposal has never received Idaho Incubation funding and has never been submitted to an Idaho Incubation fund program.

EXECUTIVE SUMMARY

This proposal describes the business case for the development and commercialization of XReader software. XReader is a software framework that automatically reads digital x-rays of bone fractures, and instantly gives physicians critical information to evaluate and manage fracture treatment. In 2009, Dr. Lujan developed XReader, and it has since generated interest in the orthopaedic trauma community, as there is a clinical need to objectively evaluate fracture healing, and no software platform currently provides this functionality. However, in order for XReader to be attractive to customers, investors and companies, three milestones must be achieved: 1) full automation of fracture evaluation, 2) development of an intuitive user interface and 3) publication of system validation. This proposal requests funds to execute these milestones and transfer this beneficial technology to medical centers. Resources from Boise State and the Boise software industry will be utilized to complete the project goals.

PROJECT OBJECTIVE AND TOTAL AMOUNT REQUESTED

In the United States, 6.2 million extremity fractures are surgically treated at an annual cost of $13 billion. Although treatment options have progressed toward less-invasive technologies that should reduce post-operative complications, evidence suggests that complication rates have actually increased.[1,2] An underlying reason for occurrences of delayed healing or non-union is that orthopaedic surgeons are unable to objectively and quantitatively evaluate the success of different treatment strategies. This has created a culture where new technologies are quickly adopted without supportive science. An example is locked plating technology. New studies have reported that locked plating is responsible for higher-rates of non-unions in certain fracture types (Appendix I, Fig. 1).[1,2] New diagnostic technology is mandated to quickly evaluate healing, and give surgeons objective feedback to make evidence-based clinical decisions.

The goal of this project is to commercialize a software platform that enables orthopaedic staff to rapidly evaluate fracture healing during patient recovery. A novel image-processing algorithm was previously developed to measure important radiographic features that are indicative of bone healing.[3] In particular, this program measures new bone growth, or callus, the hallmark of fracture healing. The algorithm can measure the projected area of callus with less than a 5% error, and compared to orthopedic surgeons, has 5-fold less variability. Prior to this algorithm, a validated method of callus measurement did not exist, and any analysis of callus size was qualitative, highly subjective, and time consuming. XReader can analyze callus size in less than one minute, a 3000% improvement over prior methods.[4] This algorithm has now been utilized in five manuscripts,[5-9] and the project director has received numerous requests from large research and clinical centers to share this technology.

The implementation of this algorithm into a software package has potential to revolutionize the assessment of fracture healing and guide the development of effective fracture treatment strategies. Although the novel algorithm has been computationally verified and clinically validated, there are two key limitations that need to be addressed prior to commercialization. First, the algorithm currently requires operator input, and a commercial tool would need to be fully automated. Second, a graphic user interface must be developed that provides simplicity and utility. Once these aims are complete and experimentally validated, this software package would have broad application to the 5800 orthopaedic centers in the United States, and would also be of value to research centers and global markets. The ***total amount requested*** to complete these aims and position this technology for a successful commercial launch is $49,989.

PROJECT RELEVANCE TO INSTITUTION

This project inherently supports Boise State's commitment to education, business, and public service. In education, this project will help advance the state-of-the-art in medical image diagnostics and will involve students in challenging tasks with real-world application. In business, this project will engage the Boise business community, and has potential to be a revenue source for future University technology transfer ventures. In public service, this project has societal significance, as complications from fracture treatments represent a substantial financial and community burden. XReader can mitigate this burden by becoming a consensus software tool that systematically identifies treatment strategies that are most appropriate for specific clinical indications. Furthermore, by improving medical diagnostics, this project can promote Boise State's mission of spurring innovation in engineering, biological science, and the health industry.

IMPACT ON IDAHO ECONOMY

The treasure valley has a formidable software development industry and is an emerging marketplace for the biomedical industry. By developing medical imaging software, this project can leverage existing infrastructure and provide growth to both of these vital industries. The developed software platform can be expanded to include a suite of products, which include three-dimensional imaging evaluation (i.e. CT and MRI), and surgical planning tools that predict healing response based upon positioning of stabilization hardware. The source code will be copyrighted by Boise State University, and licensing revenue can help support future University ventures in technology transfer.

PARTNERSHIPS

The development and commercialization of XReader software requires an interdisciplinary collaboration between engineers, clinicians, and industry partners. The project director has recruited IntelliScience®, a local software company with expertise in image processing, to participate on this project by providing console on technology and commercialization strategies (see Letters of Support, Appendix III). In addition, the lead software architect from Boise based SawToothIdeas™ has offered to support the graphic user interface design process. Ongoing collaborations will also be utilized with faculty at Boise State and physicians at three different medical centers, including St. Luke's. To improve the marketability of XReader, Dr. Lujan will also establish a new Boise based company, Injury Repair and Prevention Technology, Inc. (IRP Technology). This company will work with Boise State University to market XReader to orthopaedic clinics, and will pursue an exit strategy of selling the software to a medical imaging firm.

THE MARKET OPPORTUNITY

The advancement of high-resolution digital radiographic equipment has made imaging an essential diagnostic tool for physicians. Digital Imaging and Communications in Medicine (DICOM) files have become the standard for handling, storing and managing medical imaging, and proprietary software has been developed to access DICOM files for specific purposes. For example, OrthoView licenses a software platform for surgical planning, which is currently used by 1500 hospitals and 8000 surgeons. Software by Mirada medical, Medviso, and IntelliScience provide image-processing tools to facilitate and speed the analysis of DICOM files. However, no available software can automatically measure radiographic features that are clinically meaningful. At the 2011 Osteosynthesis and Trauma Care Workshop in Barcelona, Spain, a distinguished group of scientists and trauma surgeons concluded that the greatest deficiency in managing fracture treatment is the absence of standardized tools to evaluate healing. The proposed project can address this market need and potentially create a viable product with a substantial customer base.

The marketing strategy of XReader is to service the 6000 orthopaedic clinics and research centers in the United States. It is estimated that the market potential for this software in the U.S. is twenty-four million, and the global market includes thousands more medical centers that are potential XReader customers. The business model will include renewable revenue sources from system upgrades and new products. A key attribute of XReader is that it leverages radiographic technology that exists in nearly all medical centers, and therefore does not require clinics to invest in new capital. The rise of ultrasound reporting software in OBGYN clinics (e.g. AS-Software) demonstrates the market potential and financial impact of software reporting tools that quickly evaluate metrics with clinical significance.

A principal hurdle in gaining market entry will be acceptance from the medical community that XReader is reliable and accurate. To overcome this hurdle, a clinical validation of XReader is incorporated into the research strategy. In addition, one validation manuscript has already been published on XReader, and five more manuscripts using XReader technology are published or in-press. To further increase XReader publications, academic centers will be given the opportunity to acquire XReader at a considerable discount. This will scale the consumer risk to research centers, while expediting product acceptance and adoption by medical centers. The inherently time-consuming validation and publication process will serve as a temporary barrier from competitive companies attempting to duplicate XReader technology. This temporary barrier, and a future copyright by Boise State University on XReader's source code, should give XReader a competitive advantage to penetrate the market.

THE TECHNOLOGY

In 2010, the project director, Dr. Lujan, developed the underpinning technology for XReader using a seed grant from Legacy Research Institute in Portland (no sponsor obligation). The original motivation for this development was to gain insight into the unusual healing patterns observed in comminuted fractures treated with locked plating. Dr. Lujan therefore developed XReader to provide an objective methodology to quantify important healing metrics from radiographs.[4] Prior to XReader, all efforts to quantify clinically relevant radiographic features required manual segmentation procedures that were time consuming and highly subjective. The success and ingenuity of XReader is clearly linked to an interdisciplinary design and validation strategy.

In order to build a robust algorithm, Dr. Lujan worked with senior orthopaedic surgeons and radiologists to understand the analytical process required to identify fracture callus in radiographic film. Dr. Lujan then coded an algorithm that incorporated this process. A critical moment in the development of XReader was the recognition that clinicians needed to visually track the cortical bone surrounding a fracture site in order to differentiate callus from surrounding tissue. The initial "orientation" step was mathematically implemented into the XReader algorithm (Appendix I, Fig. 2), and provided sufficient boundary conditions to consistently identify callus in radiographs in a large retrospective series. Algorithm accuracy was verified by analyzing callus surrogates of known dimension, and was validated by comparing the measurements predicted by XReader with measurements made by three orthopaedic surgeons. Finally, the algorithm was refined by processing over 1000 radiographic images in the past two years.[5-9] The inventor has submitted a Creation of Works Disclosure to the Office of Industry Ventures at Boise State to copyright the source code and trademark the word mark, XReader.

COMMERCIALIZATION PARTNERS

Upon successful completion of this research proposal, the project director will work with Boise State University and IRP Technology to sequester investor funding. The Boise Angel Alliance fund is one potential funding source. It is projected that $400,000 will be required to support administrative costs, technical staff, and sales associates in the first three years after product launch. This sales strategy will include meetings with the medical imaging industry, on-site hospital visits, and conference exhibits. The project director has recruited IntelliScience, a local software firm, to consult during the technology transfer phase, and after successful completion of this project, a series of meetings will

determine whether a continued partnership is mutually beneficial. Based on the absence of diagnostic software for fracture care, and the success of diagnostic software in other medical industries, XReader should be an attractive product for investors.

SPECIFIC PROJECT PLAN AND DETAILED USE OF FUNDS

The project will last twelve months and has three milestones. The first milestone is to enchance the automation and speed of callus measurement from specified regions of interest. The second milestone is to develop an intuitive graphic user interface. The third milestone is to publish a peer-reviewed manuscript on the validation of XReader. Completion of these milestones will require the assistance of two undergraduate students in computer engineering (see Appendix VI for additional detail).

Completion of the first milestone will demand execution of three programming tasks. The initial task is to insert an image growing procedure that automates cortex segmentation (Appendix I, Figure 2B-C). Although this step currently requires user intervention, image growing procedures have strong potential to automatically and reliably delineate new bone growth from cortical bone. The second task is to implement an iterative subroutine to optimize the threshold values that filter radiographic artifacts. This will overcome complications observed when low-resolution radiographs are analyzed. The third task is to update the XReader code to run on integrated GPU processors. Since XReader is based on numerical arrays, parallel programming with GPU processors can improve computational speed by 100x.[10] A senior in computer engineering will complete this first milestone under the supervision of the project director, who has expertise in the first two tasks (see biosketch in Appendix V), and by consulting with an expert in GPU

programming (see Letters of Support, Appendix III). Success criteria will be an automated algorithm that processes callus size in less than a second.

The next milestone is to develop a professional graphic user interface. This user interface will have two principal design criteria: simplicity and utility. *Simplicity* is critical due to the time-restrictions of orthopaedic clinics, and through the automation achieved in Aim 1, the software has the potential to be exceedingly intuitive. To enhance a simplistic design, the program features will be scaled to only include essential commands. To support this strategy, considerable time will be invested in developing effective tutorials and help services. *Utility* of the software will be enhanced by a database that stores and displays patient and implant metrics, along with historical averages. This will give clinicians the ability to track new bone growth in patients and to quantitatively map the efficacy of specific treatment strategies (e.g. hardware positioning). A junior or senior computer engineer will develop this user interface using Altia software. The project director has extensive experience in developing graphic user interfaces (see biographical sketch), and a software architect from the Boise startup, SawToothDesign, will serve as a consultant on maintaining simplicity and integrating human factors into the software design. Success criteria for this milestone will be for new operators to gain a working knowledge of the software in less than one hour.

The third milestone will be the publication of XReader in a peer-reviewed scientific journal. This publication will describe the new technology and report system verification and validation using a methodology established by the project director.[3] In brief, system accuracy will be determined by using XReader to measure callus size in engineered bone-callus surrogates of known dimension. System validation will be determined by using XReader to automatically measure callus in fifty clinical radiographs, and then

comparing this data to the manual acquisition of callus size by five orthopaedic surgeons and radiologists. These surgeons will include collaborators from St. Luke's Hospital and medical centers in Portland and Iowa City. Success criteria for this milestone will be a system error of less than 5% and an inter-observer error that is 5x less than physicians.

EDUCATION AND OUTREACH

Most of the requested funding would be committed to the salary of two software undergraduate engineering students. Each student would be responsible for completing one of the aims, and would thus foster the educational and creative development of two motivated computer engineers. The challenging and tangible aims of this project are expected to attract high-quality students interested in creative problem solving and innovation. This project will give students extensive experience in software development, product testing, quality systems, and marketing. Undergraduate students will be solicited through the college of engineering student support service and the career center.

INSTITUTIONAL SUPPORT

Institutional support for this project will include contributions from Boise State's Northwest Tissue Mechanics Laboratory. This new laboratory will provide space and computational resources to complete the milestones. External support will come from St. Luke's Hospital, the University of Iowa and Legacy Emanuel Hospital. These research centers will provide and have provided a large number of radiographic and clinical data for system validation in milestone 3. The Office of University and Industry Ventures at Boise State has agreed to fund the intellectual property protection of XReader software.

Appendix I

Figures

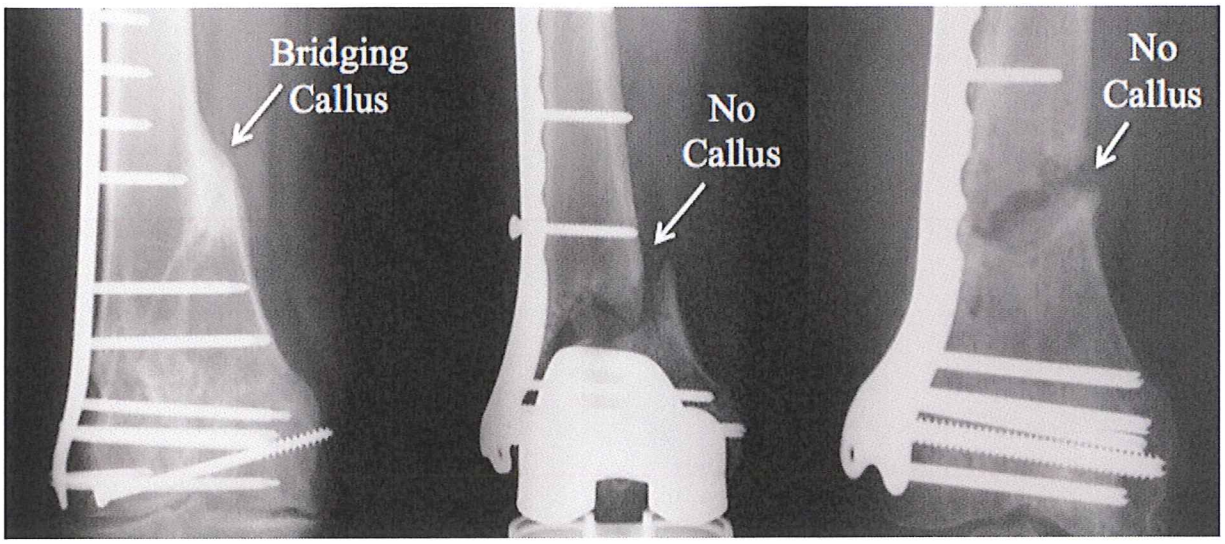


Figure 1: Radiograhs of three patients taken six-months after surgery. Left) The fracture has healed with a robust callus that bridges the fracture fragments. Middle and Right) No bridging callus present and revision surgery was required.

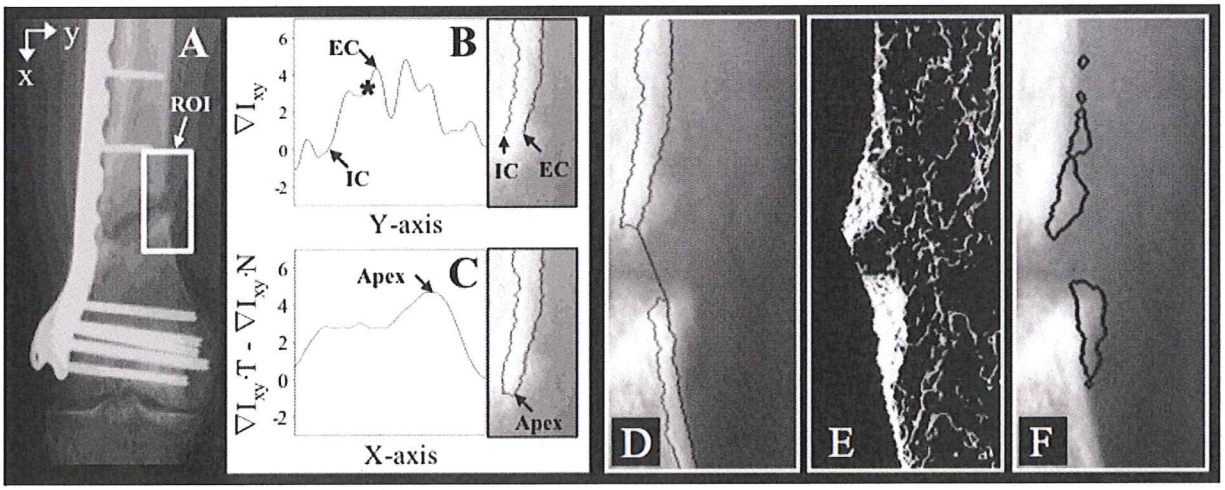


Figure 2: Digital image processing with XReader. A) Region of interest selected (ROI). B) External cortex (EC), internal cortex (IC) and C) fragment end (apex) detected using intensity gradient. D) Fragments connected. E) Algorithm uses filters, intensity gradients and morphological operations to automatically identify F) fracture callus.

Appendix II

References

(1) Henderson CE, Bottlang M, Marsh JL, Fitzpatrick DC, Madey SM. Does locked plating of periprosthetic supracondylar femur fractures promote bone healing by callus formation? Two cases with opposite outcomes. Iowa Orthop J. 2008;28:73-6.

(2) Lujan TJ, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, *Bottlang M: Locked Plating of Distal Femur Fractures Leads to Inconsistent and Asymmetrical Callus Formation: Journal of Orthopaedic Trauma, 24(3):156 62, 2010.

(3) Lujan TJ, Madey SM, Fitzpatrick DC, Byrd GD, Sanderson JM, Bottlang M: A Computational Technique to Measure Fracture Callus in Radiographs. Journal of Biomechanics, 43(4):792-5, 2010.

(4) Bhandari, M., Guyatt, G.H., Swiontkowski, M.F., Tornetta 3rd, P., Sprague, S., Schemitsch, E.H., 2002. A lack of consensus in the assessment of fracture healing among orthopaedic surgeons. J. Orthop. Trauma 16, 562–566.

(5) Morcuende, J.A., Gomez, P., Stack, J., Oji, G., Martin, J., Fredericks, D.C., et al., 2004. Effect of chemotherapy on segmental bone healing enhanced by rhBMP-2. Iowa Orthop. J. 24, 36–42

(6) Henderson CE, Lujan TJ, Bottlang M, Fitzpatrick DC, *Marsh JL: Stabilization of distal femur fractures with IM nails and locking plates: differences in callus formation. Iowa Orthopaedic Journal, 30:61-8, 2010.

(7) Bottlang M., Doornink J, Lujan TJ, Fitzpatrick DC, Marsh JL, Augat P, Rechenberg B, Lesser M, Madey SM. Effects of Construct Stiffness on Healing of Fractures Stabilized with Locking Plates. Journal of Bone and Joint Surgery (Am), Dec; 92 Suppl 2:12-22, 2010.

(8) Henderson CE, Lujan TJ, Bottlang M, Fitzpatrick DC, *Marsh JL: Healing of Distal Femur Fractures Treated with Locked Plates. Accepted Nov. 2010, Clinical Orthopaedics and Related Research. 2011 Jun;469(6):1757-65. Epub 2011 Mar 22.

(9) Bottlang M., Doornink J, Lujan TJ, Fitzpatrick DC, Madey SM. Biomechanics and Use of Far Cortical Locking in Orthopaedic Trauma. Orthopaedic Knowledge Online. Submitted Sept. 1, 2011.

(10) Thibault J., Senocak I., Accelerating incompressible flow computations with a Pthreads-CUDA implementation on small-footprint multi-GPU platforms. The journal of supercomputing. Volume 59, Number 2 (2012), 693-719, DOI: 10.1007/s11227-010-0468

Appendix III

Letters of Support

IntelliScience

May 8, 2012

Trevor Lujan
Assistant Professor
Boise State University
1910 University Dr.
Boise, ID 83725-2075

Dear Trevor,

It is my pleasure to serve as a consultant on your HERC grant entitled, "A computational method to advance the clinical treatment of bone fractures". As the CEO of IntelliScience Corporation, which specializes in feature recognition of digital images, I recognize the innovation in your software, XReader, and very much appreciate its commercial potential. As a consultant on your project, our team at IntelliScience will be happy to help you formulate commercialization strategies, and to assist with technical questions regarding image recognition. IntelliScience has considerable interest in assisting new software ventures in Boise and in continuing our research efforts. Therefore, I believe our participation in the project will be mutually beneficial and enjoyable.

I wish you success in your proposal. Please don't hesitate to contact me if there is anything I can do to help this process.

Best regards,

Joseph Daltoso
Chief Executive Officer

416 South 8th Street – Suite 90 ● Boise, ID 83702 ● Tel (208) 345-6226 Fax (208) 345-6616

Chad Harbig
User Experience Architect
319 Village Lane
Boise, ID 83702

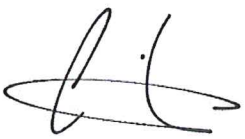
Trevor Lujan
Assistant Professor
Boise State University
1910 University Dr.
Boise, ID 83725

Dear Trevor,

I am writing to offer my services as a consultant on your grant, "A computational method to advance the clinical treatment of bone fractures". As you know, I am the User Experience Architect for a software startup called Sawtooth Ideas, Inc. and I have considerable experience designing user interfaces that incorporate human factor engineering and usability heuristics. I would be happy to consult with your team during the development of the XReader user interface, and will offer suggestions on how you can best achieve your goal of maintaining simplicity while providing excellent utility to the consumer.

I look forward to working with you on this significant project.

Best regards,



Chad Harbig

BOISE STATE UNIVERSITY

College of Engineering
Department of Mechanical & Biomedical Engineering

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http://coen.boisestate.edu/me

May 9th, 2012

Trevor Lujan
Boise State University
1910 University Dr.
Boise, ID 83725

Dear Trevor,

I am very happy to serve as a consultant on your HERC grant entitled, "A computational method to advance the clinical treatment of bone fractures". The computational method you've developed to recognize meaningful features in radiographs is an excellent candidate for parallel processing on graphics processing units (GPU). The benefits of this conversion are expected to be 100× improvements over processing using conventional processor. Based on my background in high-performance computing, which includes directing the High Performance Simulation laboratory and serving as the principal investigator of the NVIDIA CUDA Research Center at Boise State University, and my prior work experience at Los Alamos National Laboratory, I do not anticipate any problems with this conversion.

I have enjoyed working with you since you joined our department in January, and I look forward to initiating our first collaborative effort with this project.

Respectfully yours,

Inanc Senocak
Assistant Professor
Dept. of Mechanical & Biomedical Engineering
Boise State University
Boise, ID 83725
Phone: 208-426-4066
Email: senocak@boisestate.edu

Appendix IV

Facilities and Equipment

Primary Facilities

The **Northwest Tissue Mechanics laboratory** (NTM Laboratory) was started in January, 2012, by Dr. Trevor Lujan, a new assistant professor in the department of Mechanical and Biomedical Engineering. The fundamental mission of this Boise State University laboratory is to investigate significant problems in musculoskeletal health, and develop solutions that are effective and practical. A core focus of this research it to study the effect of mechanical loading on connective-tissue physiology, pathology and restoration. This research incorporates the fields of computer engineering, biomechanics, imaging, biochemistry and mechanobiology.

The NTM laboratory is located in Boise State's new Environmental Research Building and occupies 800 square feet, with an additional 150 square feet of dedicated office space. Resources include a bi-axial universal test system (E10000), three PC workstations, data acquisition hardware and software (Labview, NI), electronic test instruments (power supplies, digital oscilloscope), and a shared machine shop.

Major Equipment

1) Mechanical testing facility
    a. Instron E10000 Electropuls Biaxial Test System (10kN, 100 N-m, 100 Hz)
    b. x-y table (zaber)
    c. Force sensors (sensotec, instron)
2) Three dimensional imaging system using digital light projection.
3) Computational facilities (3 workstations) with MATLAB software, CAD software (solidworks), finite element software (COSMOS and Ansys)
4) Data Acquisition hardware and software:
    a) Instek Oscilloscopes (GDS-1022)
    b) Data acquisition, National Instrument
4) Biomedical Equipment
    a) Dissection table, fully equipped with tools and supplies.
    b) Medical X-ray Illuminator
5) Shared resources:
    a) Machine Shop
    b) Meeting and seminar rooms
    c) Imaging: TEM, confocal, AFM, micro CT
    d) RT-PCR, microplate reader, fluorescence microscope,

Appendix V

Project Director Biosketch and CV

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Lujan, Trevor	Assistant Professor

INSTITUTION AND LOCATION	DEGREE	YEAR	FIELD OF STUDY
University of Wisconsin, Madison, WI	B.S.	1998	Mechanical Engineering
University of Utah, Salt Lake City, UT	Ph.D.	2007	Bioengineering

A. Personal Statement

The core focus of Dr. Lujan's research is to develop and commercialize products related to the repair and prevention of musculoskeletal injury. Dr. Lujan has pursued projects that can significantly contribute to reducing the financial and societal burden of musculoskeletal disease, and has successfully administered projects from idea conception to technology transfer. Dr. Lujan spent four years developing and licensing new orthopaedic products at Legacy Biomechanics Laboratory. This includes the continued development of MATE, a mechatronic device that facilitates cartilage engineering. The software architecture and user interface for the commercial MATE system was designed by Dr. Lujan. In his new position at Boise State University, Dr. Lujan is directing the Northwest Tissue Mechanics laboratory, where he will transfer his working knowledge of product commercialization to the Boise community.

B. Positions and Honors

Positions and Employment

01/2012 – Present	Assistant Professor, Mechanical and Biomedical Eng., Boise State University, Boise, ID
01/2012 – Present	Director, Northwest Tissue Mechanics Laboratory, Boise State University, Boise, ID
01/2012 – Present	Affiliate Faculty, Material Science Eng., Boise State University, Boise, ID
10/2010 – 12/2011	Assistant Scientist, Legacy Research Institute, Portland, OR
08/2010 – 12/2011	Adjunct Assistant Professor, University of Portland, OR
10/2007 – 10/2010	Research Associate, Legacy Research Institute, Portland, OR
08/2002 – 09/2007	Research Assistant, Bioengineering, Univ. of Utah, Salt Lake City, UT
09/2001 – 05/2002	Research Assistant, Mechanical Eng., Univ. of Canterbury, Christchurch, New Zealand
09/1998 – 07/2000	Technical Analyst, Accenture, San Francisco, CA
01/1998 – 05/1998	Mechanical Engineering Intern, Power Engine Industry Consultants, Madison, WI
05/1997 – 09/1997	Mechanical Engineering Intern, St. Jude Medical, R&D Dpt, St. Paul, MN
05/1996 – 08/1996	Mechanical Engineering Intern, VA Hospital, Department of Bioengineering, Madison, WI

Honors

Award of Excellence from Academy of Orthopaedic Surgeons – 2010 (Author)
Mid America Award – Best Paper – 2010 (Author)
Chair, Graduate Student Advisory Committee, Dept of Bioengineering, Univ. of Utah
Provost's Honor list at Univ. of Utah – All semesters enrolled, 2002 - 2007
Provost's Honor list at Univ. of Wisconsin – All semesters enrolled, 1993 - 1998
Runner-up, Bioengineering graduate student poster competition – 2004, Univ. of Utah
Team member on national champion hybrid car team – 1997/98, Univ. of Wisconsin
Team lead on award winning engineering EXPO exhibit – 1996/97, Univ. of Wisconsin
Rogers Design Scholarship – 1996/97 Academic Year, Univ. of Wisconsin
Elliot Scholarship – 1995/96 Academic Year, Univ. of Wisconsin

Activities and Affiliations (selected)

Orthopaedic Research Society, since 2008
Biomedical Engineering Society, since 2005

C. Relevant peer-reviewed publications (reverse chronological order, selected from 14 original research articles and 21 extended abstracts; *=corresponding author)

Original Research Articles

1. Henderson CE, **Lujan TJ**, Bottlang M, Fitzpatrick DC, *Marsh JL: 2010 mid-America Orthopaedic Association Physician in Training Award: Healing of Distal Femur Fractures Treated with Locked Plates. Clinical Orthopaedics and Related Research. 2011 Jun; 469(6)1757-65.
2. ***Lujan TJ,** Wirtz, Madey SM, Bottlang M. A novel bioreactor for the dynamic stimulation and mechanical evaluation of multiple tissue engineered constructs. Tissue Engineering Part C Methods. 2011 Mar; 17(3):367-74.
3. *Bottlang M., Doornink J, **Lujan TJ**, Fitzpatrick DC, Marsh JL, Augat P, Rechenberg B, Lesser M, Madey SM. Effects of Construct Stiffness on Healing of Fractures Stabilized with Locking Plates. Journal of Bone and Joint Surgery (Am), Dec; 92 Suppl 2:12-22, 2010.
4. ***Lujan TJ**, Madey SM, Fitzpatrick DC, Byrd GD, Sanderson JM, Bottlang M: A Computational Technique to Measure Fracture Callus in Radiographs. Journal of Biomechanics, 43(4):792-5, 2010.
5. **Lujan TJ**, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, *Bottlang M: Locked Plating of Distal Femur Fractures Leads to Inconsistent and Asymmetrical Callus Formation: Journal of Orthopaedic Trauma, 24(3):156-62, 2010.

Grant Funding

Current, Extramural

Organization: National Institutes of Health, NINDS, R41
Title: Advanced Bicycle Helmet Technology for Prevention of Traumatic Brain Injury
Amount: $144,000 total costs
Role: co-investigator
Dates: 11/1/11 – 11/1/12
Synopsis: The overall goal of this grant is to conduct a feasibility study on an advanced impact mitigation system that absorbs rotational energy to reduce the rotational accelerations that cause traumatic brain injury.

Pending

Organization: National Institutes of Health, NIAMS, R42
Title: A cost-effective bioreactor to advance functional tissue engineering of cartilage
Amount: $660,000 total costs (2 years)
Role: PI
Dates: 11/1/12 - 10/31/14
Synopsis: This phase II grant will expand the bioreactor technology that was developed in the phase I proposal that was successfully completed 5/11. Dr. Lujan is the project director and has been the software architect for the software platform developed to operate this mechatronic device. This grant was originally submitted 8/5/2011 and received a high priority score in the top 25 percentile. It was resubmitted 4/5/2012.

May 1, 2012

Curriculum Vitae

Trevor J. Lujan, Ph.D.

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Boise State University
1910 University Dr.
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trevor.lujan@gmail.com

PERSONAL

Date of Birth:	May 22, 1975. Minneapolis, Minnesota.
Spouse:	Tenneal E. Lujan, married June 22, 2002.
Daughter:	Cecilia M. Lujan, born Feb. 25, 2009

EDUCATION

Dec. 2007	Ph.D., Bioengineering University of Utah, Salt Lake City
May 1998	B.S., Mechanical Engineering University of Wisconsin, Madison
May 1998	Technical Communications Certificate University of Wisconsin, Madison

PROFESSIONAL / ACADEMIC / TEACHING

1/2012 – present	Assistant Professor Mechanical and Biomedical Engineering Boise State University, Idaho
11/2010 – present	Director Northwest Tissue Mechanics Laboratory Boise State University, Idaho
11/2010 – 12/2011	Assistant Scientist Biomechanics Laboratory Legacy Research, Oregon

8/2010 – 12/2011	Adjunct Assistant Professor Mechanical Engineering University of Portland, Oregon
10/2007 – 10/2010	Research Associate Biomechanics Laboratory Legacy Research, Oregon
8/2005 – 8/2006	Chair Graduate Student Advisory Committee, Bioengineering University of Utah, Utah
8/2002 – 8/2005	Council Member Graduate Student Advisory Committee, Bioengineering University of Utah, Utah
8/2003 – 8/2007	Project Engineer BioAid Consulting Salt Lake City, Utah
8/2002 – 9/2007	Research Assistant Bioengineering University of Utah, Utah
9/2001 – 7/2002	Research Assistant Mechanical Engineering University of Canterbury, New Zealand
9/1998 – 7/2000	Technical Analyst Accenture (formerly Andersen Consulting) San Francisco, CA
1/1998 – 5/1998	Technical Writer Power Engine Industry Consultants Madison, WI
5/1997 – 9/1997	Engineering Intern St. Jude Medical St. Paul, MN
5/1996 – 8/1996	Engineering Intern VA Hospital, Bioengineering Madison, WI

Teaching

Spring 2012	Instructor, Continuum Mechanics (ME510) Mechanical and Biomedical Engineering, Boise State Univ.
Spring 2011	Guest Lecturer (Constitutive Models), Biomechanics Mechanical Engineering, University of Portland
Fall 2010	Instructor, Biomaterials Science (ME491) Mechanical Engineering, University of Portland *www.biomechresearch.org/staff/lujan/teaching/ME491.htm*
Spring 2010	Guest Lecturer (Constitutive Models), Biomechanics Mechanical Engineering, University of Portland
Spring 2007	Guest Lecturer (Poroelasticity), Biosolids (BIOEN 7210) Bioengineering, University of Utah
Fall 2005	Teaching Assistant, Biomechanics (BIOEN 5201, 6201), Department of Bioengineering, University of Utah
Spring 2000	Instructor, Introduction to C Programming Accenture, San Francisco, CA
Spring 1998	Instructor for science outreach at elementary schools University of Wisconsin - Madison

Graduate Students – Current

Christina Sundgren	2012-	(B.S., Mechanical Eng., Boise State, EGD 2014)

Undergraduate Students – Current

Evan Rust	2012-	(B.S., Mechanical Eng., Boise State, EGD 2014)
Ashley Madsen	2012-	(B.S., Mechanical Eng., Boise State, EGD 2014)

Undergraduate Students – Alumni

Susanna Cai	2011	(B.S., Mechanical Eng., Duke Univ., EGD 2015)
Kevin Burfeind	2009-2011	(B.S., Exercise Science, Willamette Univ., 2011)
Kyle Wirtz	2008-2010	(B.S., Mechanical Eng, Portland State Univ)
Josiah Brown	2010	(B.S., Mechanical Eng., Duke Univ., EGD 2013)
Meghan O'Donovan	2008	(B.S., Mechanical Engineering, U. of Rochester 2009)
Nathan Jacobs	2006-2007	(B.S., Biomedical Engineering, U. of Utah, 2007)
Brent Thompson	2003-2006	(B.S., Biomedical Engineering, U. of Utah, 2006)

Tim Plazier	2003-2004 (B.S., Electrical Engineering, U. of Utah, 2006)
Spencer Lake	2002-2003 (B.S., Biomedical Engineering, U. of Utah, 2006)
Michael Small	2001-2003 (B.S., Chemistry, U. of Utah, 2006)

HONORS AND AWARDS

Award of Excellence from Academy of Orthopaedic Surgeons – 2010 (Author)
Mid America Award – Best Paper – 2010 (Author)
Provost's Honor list at U. of Utah – All semesters enrolled, Fall 2002 to Spring 2007
Provost's Honor list at U. of Wisconsin – All semesters enrolled, Fall 1993 to Spring 1998
Runner-up, Bioengineering graduate student poster competition – 2004, U. of Utah
Team member on national champion hybrid car team – 1997/98, U. of Wisconsin
Team lead on award winning engineering EXPO exhibit – 1996/97, U. of Wisconsin
Rogers Design Scholarship – 1996/97 Academic Year, U. of Wisconsin
Elliot Scholarship – 1995/96 Academic Year, U. of Wisconsin

INVITED SPEAKER

Osteosynthesis & Trauma Care Foundation Workshop. "Periosteal Callus Quantificaiton from Plain Radiographs", Barcelona, Spain, Oct. 2011.

SERVICE

Review and Editorial Duties

Reviewer, Journal of Biomechanics
Reviewer, Journal of Bone and Joint Surgery
Reviewer, Connective Tissue Research
Reviewer, Injury
Reviewer, Journal of Applied Biomechanics
Reviewer, Tissue Engineering

Organization and Chairing at Scientific Meetings

Reviewer, ASME SBC (Student Paper Competition, June, 2011)
Reviewer, ASME SBC (Student Paper Competition, June, 2012)

Committee Membership

Member, Graduate Committee, Mechanical & Biomedical, Boise State, '12-13'
Member, Biomedical Committee, Mechanical & Biomedical, Boise State '12-13'
Chair, Graduate Student Advisory Committee, Bioengineering, U. Utah, '06-07'
Member, Graduate Student Advisory Committee, Bioengineering, U. Utah, '02-06'

SOCIETIES

Orthopaedic Research Society, since 2008
Biomedical Engineering Society, since 2005

PUBLICATIONS

Thesis/Dissertation

Lujan TJ: Multiscale Relationships in Ligament Mechanics. PhD Dissertation, University of Utah, Dec. 2007. (http://mrl.sci.utah.edu/papers/lujan_dissertation_final.pdf)

Refereed Journal Articles (* = corresponding author)

1. **Lujan TJ**, Lake SP, Plaizier TA, Ellis BJ, *Weiss JA: Simultaneous measurement of three-dimensional joint kinematics and tissue strains with optical methods. ASME Journal of Biomechanical Engineering, 127:193-197, 2005.
2. *Weiss JA, Gardiner JC, Ellis BJ, **Lujan TJ**, Phatak NS: Three-dimensional finite element modeling of ligaments: Technical aspects. Medical Engineering and Physics 27(10):845-61, 2005.
3. Ellis BJ, **Lujan TJ**, Dalton MS, *Weiss JA: MCL insertion site and contact forces in the ACL-Deficient knee. Journal of Orthopaedic Research 24(4):800-810, 2006.
4. **Lujan TJ**, Underwood CJ, Henninger HB, Thompson BM, *Weiss JA: Effect of dermatan sulfate glycosaminoglycans on the quasi-static material properties of the human medial collateral ligament. Journal of Orthopaedic Research 25(7):894-903, 2007.
5. **Lujan TJ**, Dalton MS, Thompson BM, Ellis BJ, *Weiss JA: Effect of ACL Deficiency on MCL strains and joint kinematics. Journal of Biomechanical Engineering 129(3):386-92, 2007.
6. **Lujan TJ**, Underwood CJ, Jacobs N, *Weiss JA: Contribution of glycosaminoglycans to viscoelastic tensile behavior of human ligament. Journal of Applied Physiology 106(2): 423-31, 2009.
7. **Lujan TJ**, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, *Bottlang M: Locked Plating of Distal Femur Fractures Leads to Inconsistent and Asymmetrical Callus Formation: Journal of Orthopaedic Trauma, 24(3):156-62, 2010.
8. ***Lujan TJ**, Madey SM, Fitzpatrick DC, Byrd GD, Sanderson JM, Bottlang M: A Computational Technique to Measure Fracture Callus in Radiographs. Journal of Biomechanics, 43(4):792-5, 2010.
9. Henderson CE, **Lujan TJ**, Bottlang M, Fitzpatrick DC, *Marsh JL: Stabilization of distal femur fractures with IM nails and locking plates: differences in callus formation. Iowa Orthopaedic Journal, 30:61-8, 2010.
10. *Bottlang M., Doornink J, **Lujan TJ**, Fitzpatrick DC, Marsh JL, Augat P, Rechenberg B, Lesser M, Madey SM. Effects of Construct Stiffness on Healing of Fractures Stabilized with Locking Plates. Journal of Bone and Joint Surgery (Am), Dec; 92 Suppl 2:12-22, 2010.
11. ***Lujan TJ,** Wirtz, Madey SM, Bottlang M. A novel bioreactor for the dynamic stimulation and mechanical evaluation of multiple tissue engineered constructs. Tissue Engineering Part C Methods. 2011 Mar;17(3):367-74
12. Henderson CE, **Lujan TJ**, Bottlang M, Fitzpatrick DC, *Marsh JL: Healing of Distal Femur Fractures Treated with Locked Plates. Accepted Nov. 2010, Clinical Orthopaedics and Related Research. 2011 Jun;469(6):1757-65. Epub 2011 Mar 22.

13. Bahney CS, **Lujan TJ**, Hsu CW, Bottlang M, West JL, *Johnstone B. Visible light photoinitiation of mesenchymal stem cell-laden bioresponsive hydrogels. European Cells and Matrix. 2011 Jul 15;22:43-55.
14. *Bottlang M., Doornink J, **Lujan TJ**, Fitzpatrick DC, Madey SM. Biomechanics and Use of Far Cortical Locking in Orthopaedic Trauma. Orthopaedic Knowledge Online. In Press.

Abstracts

Lujan TJ, Dalton MS, Lake SP, Ellis BJ, Rosenberg TD, Weiss, JA: ACL injury alters MCL strain during anterior-posterior but not varus-valgus loading. Proc 50th Annual Orthopaedic Research Society Meeting, 29:1272, 2004 (Poster).

Dalton MS, Ellis BJ, **Lujan TJ**, Weiss JA: MCL insertion site and contact forces in the ACL-deficient knee. Proc 51st Annual Orthopaedic Research Society Meeting, 30:814, 2005.

Ellis BJ, Dalton MS, **Lujan TJ**, Weiss JA: Subject-specific finite element modeling of MCL mechanics in the ACL-deficient knee. Proc ASME Summer Bioengineering Conference, June 2005 (Podium).

Henninger HJ, Underwood CJ, **Lujan TJ**, Weiss JA: Decorin proteoglycans do not resist shear deformation in ligament. Biomedical Engineering Society Conference Annual Meeting, October 2005 (Poster).

Lujan TJ, Thompson BM, Ellis BJ, Weiss JA: Effect of ACL transection on MCL strains during anterior tibial translation and valgus rotation. 1st Annual Mountain West Biomedical Engineering Conference, August 2005 (Poster).

Lujan TJ, Underwood CJ, Henninger HB, Weiss JA: Dermatan Sulfate glycosaminoglycans do not contribute to the shear or tensile material behavior of the human MCL. 52nd Annual Meeting of the Orthopaedic Research Society, February 2006.

Underwood CJ, Henninger HB, **Lujan TJ**, Weiss JA: Glycosaminoglycan concentration and species in human knee ligaments. 52nd Annual Meeting of the Orthopaedic Research Society, February 2006 (Poster).

Henninger HB, **Lujan TJ**, Underwood CJ, *Weiss JA: Distribution and mechanical implications of dermatan sulfate in human medial collateral ligament. ASME Summer Bioengineering Conference, June 2006 (Poster).

Lujan TJ, Ellis BJ, Thompson BM, Weiss JA: MCL Mechanics in the ACL-Deficient Knee. An experimental and finite element based study. 5th World Congress of Biomechanics, August 2006 (Podium).

Underwood CJ, **Lujan TJ**, Henninger HB, Weiss JA: The Distribution and Influence of Dermatan Sulfate in Ligament Biomechanics. 5th World Congress of Biomechanics, August 2006 (Podium).

Underwood CJ, **Lujan TJ**, Thompson BM, Henninger HJ, Weiss JA: Influence of sulfated glycosaminoglycans on mechanics of the MCL. Biomedical Engineering Society Conference Annual Meeting, October 2005 (Podium).

Lujan TJ, Underwood CJ, Jacobs NT, Weiss JA: Tissue swelling during extended material testing of ligaments. ASME 2007 Summer Bioengineering Conference, June 2007 (Poster).

Lujan TJ, Underwood CJ, Jacobs NT, Weiss JA: Contribution of glycosaminoglycans to the viscoelastic tensile behavior of human ligament. 54th Annual Meeting of the Orthopaedic Research Society, February 2008 (Podium).

Lujan TJ, Henderson CE, O'Donovan M, Madey SM, Fitzpatrick DC, Bottlang M: Automated measurement of callus formation. ASME Summer Bioengineering Conference, June 2009 (Poster).

Bottlang M, **Lujan TJ**, Phelan D, Henderson CE, Marsh JL, Fitzpatrick DC, Madey SM: Stabilization of distal femur fractures with IM nails and locking plates: differences in callus formation. Orthopaedic Trauma Association, January 2010 (Poster).

Bottlang M, Doornink J, **Lujan TJ**, Fitzpatrick D, Madey: Far-cortical locking of distal femur fractures. Accepted, American Academy of Orthopaedic Surgeons, February 2010 (Scientific Exhibit).

Lujan TJ, Henderson CE, Madey SM, Fitzpatrick DC, Marsh JL, Bottlang M: Factors that Influence Callus Formation in Locked Plating of Distal Femur Fractures. Academy of Orthopaedic Surgeons, February 2010 (Poster).

Henderson CE, **Lujan TJ**, Fitzpatrick DC, Bottlang M, Marsh JL: Lack of Callus Predicts Nonunion After Locking Plate for Distal Femur Fractures: Are Locking Plates Too Stiff. Mid America Orthopaedic Association, April 2010 (Podium).

Doornink J, Madey SM, Fitzpatrick DC, **Lujan TJ**, Bottlang M: Analysis of periosteal callus formation in locked plating of distal femur fractures. 56th Annual Meeting of the Orthopaedic Research Society, March 2010 (Poster).

Lujan TJ, Wirtz K, Madey SM, Bottlang M: A bioreactor to mechanically stimulate and evaluate tissue-engineered constructs during culture. Biomedical Engineering Society Conference Annual Meeting, May 2010 (Poster).

Lujan TJ, Wirtz K, Madey SM, Bottlang M: High-Throughput Mechanical Evaluation of Tissue Engineered Constructs During Incubation. Accepted, 2011 Annual Meeting of the Orthopaedic Research Society, Jan. 2011 (Podium).

GRANTS

Current, Extramural

Organization: National Institutes of Health, NINDS, R41
Title: Advanced Bicycle Helmet Technology for Prevention of Traumatic Brain Injury
Amount: $144,000 total costs
Role: co-investigator
Dates: 5/1/11 – 5/1/12
Synopsis: The overall goal of this grant is to conduct a feasibility study on an advanced impact mitigation system that absorbs rotational energy to reduce the rotational accelerations that cause traumatic brain injury.

Organization: Zimmer Orthopaedic
Title: Clinical Trial for MotionLoc Screws
Amount: $189,000 total costs
Role: co-investigator
Dates: 5/1/11 – 5/1/12
Synopsis: This 33 patient prospective study assesses the health benefit of MotionLoc screws through imaging (radiographs and CT) and patient follow-up.

Pending

Organization: National Institutes of Health, NIAMS, R42
Title: A cost-effective bioreactor to advance functional tissue engineering of cartilage
Amount: $595,000 total costs (2 years)
Role: PI
Dates: 5/1/12 - 4/30/14
Synopsis: This phase II grant will expand the bioreactor technology that was developed in the phase I proposal (submitted Aug. 5, 2011)

Planned

Organization: National Institutes of Health, NCCAM, R01
Title: Mechanobiology of Ligament Repair
Role: PI
Planned Submission: 10/1/2011
Synopsis: This research grant will investigate the role of mechanical loading in ligament repair and remodeling. Study objectives include determining mechanical thresholds for functional healing and validating a remodeling algorithm to predict tissue regeneration.

Organization: National Institutes of Health, NIAMS, R21
Title: A computational method to quantify fracture healing from computed tomography.
Role: PI
Planned Submission: 2/16/2012 (projected)
Synopsis: This exploratory grant will develop a computational framework for measuring features in CT scans that indicate fracture union.

Past, Extramural

Organization: National Institutes of Health, NIAMS, 1R41AR059433-01.
Title: A cost-effective bioreactor to advance functional tissue engineering of cartilage
Amount: $100,175 total costs
Role: PI
Dates: 5/1/10 – 5/1/11
Synopsis: The aim of this grant is to perform a feasibility study on a bioreactor that can facilitate the rapid discovery of biophysical and biochemical conditions that promote the synthesis of mechanically viable tissue.

Organization: Medical Research Foundation of Oregon (seed grant)
Title: Mapping the Functional Development of Engineered Cartilage: Establishing a Methodology.
Amount: $40,000
Role: PI
Dates: 5/31/08 - 5/31/10

Description: The aim of this study was to develop a methodology to map the mechanical development of engineered cartilage during culture. Results from this study have led to a published manuscript and preliminary data for a funded STTR grant.

Organization: Legacy Research Advisory Committee (seed grant)
Title: Objective Assessment of Fracture Healing using Digital Radiographs
Amount: $20,000
Role: PI
Dates: 6/01/08 - 6/01/09
Synopsis: This research produced a computational method to objectively measure radiographic features that correlate to fracture healing. This method was published and utilized by four subsequent clinical studies.

Organization: National Institutes of Health (NIAMS #2R01AR047369-05)
Title: Origins of Elasticity and Viscoelasticity in Knee Ligaments
Amount: $800,000 total direct costs
Role: Funded student. Assisted writing preliminary data section of grant. PI - JA Weiss
Dates: 9/1/04 - 8/31/09

Organization: National Institutes of Health (NIAMS), #R01-AR47369-01
Title: Mechanics of the MCL in Normal and ACL-Deficient Knees
Amount: $425,000 total direct costs
Role: Funded student. PI - JA Weiss
Dates: 9/1/2000 - 8/31/2004

TECHNICAL SKILLS

Proficient	C, C++, SQLPLUS, JavaScript, DHTML, Informatica, Visual Basic, SigmaStat, SPSS, Matlab, LabVIEW, Maple, DMAS, MS Access, MS Project, Project Workbench, Truegrid, LSPost, NIKE3D, FEBio and UNIX.
Skilled	Amira, ANSYS, Truegrid, DOS, ASP, SQL, SQL Server, ACAD, SolidWorks, and Oracle

OVERSEAS TRAVEL

8/2004 - 1/2005	Studied Spanish and traveled throughout South America.
8/2000 - 8/2002	Traveled, worked and lived in Southeast Asia, Australia and New Zealand.
9/1997 - 12/1997	Independent semester abroad in Western Europe.

Appendix VI
Budget Justification

Dr. Trevor Lujan Idaho Incubation Fund Program FY 2013
Budget Justification

A. Faculty and Staff
Principal Investigator Dr. Trevor Lujan requests 1.5 months of summer support. Dr. Lujan will be responsible for implementing the research plan, meeting scientific objectives and milestones, publishing results and maintaining budget performance. Additionally, Dr. Lujan will mentor and supervise the student research assistants. Total PI salary request is $12,580.

B. Visiting Professors
None.

C. Post Doctoral Associates / Other Professionals
None.

D. Graduate / Undergraduate Students
Graduate and undergraduate students: Funds are requested for 2 or more undergraduate students to assist in the research. Hourly wages for undergraduate students are $10-$12, depending upon experience. Students will assist with software development, product testing, quality systems, and marketing. Students work up to 20 hours/week during the academic year and up to 40 hours/week during the summer. Total student salary request is $26,000.

E. Fringe Benefits
The fringe benefits for the PI are 33% of salary, and include retirement, health, dental and life insurance and employment taxes. The fringe benefits for the students cover employment taxes and average 6% during the year. Total fringe benefits request is $5,709.

F. Equipment
None.

G. Travel
None.

H. Participant Support
None.

I. Other Direct Costs

Materials and supplies: $500 is requested for software and $1,000 for consumable laboratory supplies that will be used to engineer fracture surrogates to quantify the accuracy of the software. Total materials and supplies request is $1,500.

Consultant: $4,200 is requested for two industry consultants. Once consultant will provide assistance in developing a professional graphic user interface that account for human factor engineering. The second consultant will assist with product positioning for commercialization and acquisition of investment funding. The consultants will work approximately 40 hours at an hourly rate of $100.

J. Total Costs

Total costs for the project are $49,989.

K. Amount Requested

Amount requested is $49,989.