***Project Summary***

We propose a three-day conference on time scales calculus at the University of Nebraska-Lincoln (UNL), October 25-27. The main goals of this conference will be to help recent Ph.D.s and graduate students in the field to meet experienced researchers, to learn about recent developments in differential equations, to exchange ideas with one another, and to develop collaborations for future research. The primary topics will be aspects of differential equations, difference equations, time scales calculus, and fractional calculus. Speakers will be invited to discuss connections among these topics.

We have invited several leading analysts to give plenary lectures and we have received positive responses from all of them. These include: Ravi Agarwal, Martin Bohner, Saber Elaydi, John Graef, Johnny Henderson, and Gerry Ladas.

We seeks support primarily for a target group of participants: those who are recent Ph.D.s, graduate students, women, and faculty from under-represented groups or primarily undergraduate institutions. Most of the talks will be accessible to graduate students and will demonstrate the main problems and techniques in the discipline.

***Intellectual Merit.*** The aim of this conference is to stimulate cooperative research among researchers in time scales analysis. Research in time scales calculus calculus has been blossoming for the past 15 years, with recent activity transforming the field. There is also extensive interaction with researchers in differential equations, difference equations, *q* calculus, fractional calculus, mathematical biology, economics, and engineering. The proposed conference will provide an opportunity for analysts to interact and establish research connections with each other; in particular the targeted participants will benefit from the interaction and from seeing recent developments in the field of time scales calculus and its relationships with other areas.

***Broader Impact.*** The primary impact of the conference will be its dissemination of recent ideas on an important topic – time scales calculus. Participants, including those from primarily undergraduate institutions and traditionally under-represented minorities, will take ideas from the conference back to their colleagues and students, stimulating further research and mathematical enrichment at their home institutions. The relatively small size of the meeting and the focus on specific areas of research will enable participants to establish collaborative relationships more effectively than would be possible at larger professional meetings.

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***Project Description***

Nebraska Time Scales Calculus Conference

University of Nebraska, October 2013

***Overview.*** Over the past two decades, much progress has been made in the unification of discrete and continuous analysis. The theory of time scales was introduced by Stefan Hilger in his Ph.D. thesis in 1988 [ ]. A time scale T is any arbitrary, nonempty, closed subset of the real numbers. The calculus on time scales was developed in such a way that when T = R, the theory recovers differential equations and when T = Z, the theory of difference equations is revealed. However, time scales research does more than simply unify differential and difference equations. It also serves to extend these areas of research. The results in time scales reveal the importance of the *graininess* in the time scale, that is, the “gap” between a point in the time scale and its nearest neighbor. Because of this, even proofs of results that are known for both differential equations and difference equations can be quite difficult to come by for general time scales - simply restating the known proofs typically does not work. The strength of the time scales theory is that it is not restricted to purely continuous or regularly discrete applications. As a result, this area of research has received a great deal of attention. For example, this theory can be used to simulate combustion in engines [ ], model the spread of the West Nile virus [ ], and represent interactions in quantum mechanics [ ]. In all of these situations, there is a mixture of stop-start and continuous processes that is problematic to model with differential equations or difference equations alone. Currently, researchers in time scales analysis are involved with nonlinear oscillation theory, boundary value problems, fixed point theory, and fractional calculus. There has been an emphasis on applications in mathematical biology, engineering, and economics.

With the recent activity in this field, it is important to have venues where recent Ph.D.s, graduate students, and faculty from primarily undergraduate institutions can learn about recent developments and establish research connections with other workers in the area. We propose a three-day time scales calculus conference at the University of Nebraska-Lincoln (UNL), October 25-27, 2013. The main goals of this conference will be to help recent Ph.D.s and graduate students in the field to:

1. interact with leading researchers in time scales calculus,
2. learn about recent developments in time scales calculus and related fields,
3. exchange ideas with one another, and
4. develop collaborations for future research.

The primary topics will be aspects of nonlinear oscillation theory, integral transform theory, fixed point theory, fractional calculus, particularly as they relate to time scales calculus. Connections among these various topics and their applications to biology, engineering, and economics will be an important aspect of the conference. The number of participants is projected to be around 50. The talks will be accessible to graduate students and will highlight major problems and techniques as well as connections with other topics of the conference.

***Plenary Speakers.*** Five leaders in time scales analysis have agreed to give plenary lectures.

* ***Ravi Agarwal***, Professor and Chair of the Department of Mathematics at Texas A&M University – Kingsville, has made fundamental contributions to nonlinear analysis, differential and difference equations, fixed point theory, and general inequalities. His 800+ publications have been cited by thousands of researchers and have been done in collaboration with over 300 co-authors.
* ***Martin Bohner***, Professor of Mathematics at Missouri University of Science and Technology is a world-renowned leader on time scales calculus. His contributions to the time scales community put him at the forefront of the research in this area. He has written over 100 papers and has co-authored *Dynamic Equations on Time Scales: An Introduction with Applications* and he has co-edited *Advances in Dynamic Equations on Time Scales*, two of the most pivotal texts on time scales calculus.
* ***Saber Elaydi***, Professor and Chair of the Department of Mathematics at Trinity University is a leading expert on difference equations and discrete dynamical systems as applied to mathematical biology. He has published over 100 articles and books on these topics and will be a dynamic speaker for our conference.
* ***John Graef***, Professor and Chair of the Department of Mathematics at the University of Tennessee at Chattanooga is an expert on ordinary and functional differential equations, difference equations, impulsive systems, differential inclusions, and dynamic equations on time scales. His work has been applied to nonlinear oscillation theory, boundary value problems, and mathematical modeling of biological systems.
* ***Johnny Henderson***, Distinguished Professor of Mathematics at Baylor University is an internationally recognized researcher in boundary value problems for ordinary differential equations, finite difference equations, and dynamic equations on time scales. He has authored over 300 papers in this area and was named an AMS Fellow in November, 2012.

***Support for the Conference.*** We seek NSF support mainly for the travel expenses (lodging and airfare) of the plenary speakers and the participants who are graduate students or recent Ph.D.s. Efforts will be made to ensure ample participation by women, mathematicians from traditionally underrepresented minorities, and by faculty from primarily undergraduate institutions.

***Merits of the Conference.*** The participants of the Nebraska Time Scales Calculus Conference will represent a diverse group of researchers. We anticipate a large portion of participants who are recent doctoral recipients, faculty members from primarily undergraduate institutions, women and underrepresented minorities, and graduate students.

Regular interaction with other researchers is essential to a mathematician’s professional development, and participation in research conferences is a crucial part of the development of a mathematician’s research program. Faculty members from primarily teaching institutions often have heavy teaching and service loads, lack of resources, and limited travel support for research; these factors make it difficult to continue their research. Also, faculty members and graduate students from universities with small graduate programs often have limited opportunities for seminars and graduate courses. We intend to provide an opportunity for these mathematicians to interact with their peers, to exchange ideas, to encounter new ideas, and to develop collaborative research projects. The relatively small size of the meeting will create an atmosphere that will enhance each of these activities.

***Planned Activities.*** In addition to five plenary talks, there will be slots for 15 twenty-minute talks during the three-day conference. Most of the twenty-minute talks will be given by recent Ph.D.s or advanced graduate students. Other activities will include a conference banquet and a reception.

***Recruitment Plan.*** The conference will be open to all interested mathematicians. Our advertising and recruitment will target mathematics departments in the Midwest, those with small graduate programs, and those at primarily teaching institutions. We will make special efforts to recruit women and underrepresented minorities. A website of the conference with an online registration feature will be set up. The conference will be advertised in the AMS meeting calendar.

***Appropriateness of the Venue.*** Over the past several years, the UNL Department of Mathematics has become a leading center of time scales analysis research. The department is recognized as a model department with a successful graduate program that provides especially strong support for its students. In 1998, the department received a Presidential Mentoring Award in recognition of its success in mentoring female Ph.D. students. In 2004 the department received a National Science Foundation MCTP grant for the mentoring of current students, students entering graduate school, and recent Ph.D. recipients. The department hosts many major events to promote mathematical research and can be relied upon to produce an event of high quality. The proposed conference will build upon the department’s research excellence in time scales analysis and its tradition of mentoring developing mathematicians.

The conference was originally conceived as a tribute to Al Peterson, the Charles Bessey Professor of Mathematics. He is currently in his 45th year at UNL and in this time he has advised over 25 graduate students in differential equations, difference equations, and time scales calculus. The Nebraska Time Scales Calculus Conference will emphasize research areas in which Al Peterson has worked and will continue his tradition of helping young mathematicians.

***Budget Explanation.***

Travel Expenses for 5 plenary speakers:

 Transportation

 Lodging (2 nights @ $n each)

 Meals (3 days @ $n each)

Total support for 5 plenary speakers

Participation support for 50:

 Transportation

 Lodging (2 nights @ $n per room, shared accommodations)

 Meals (3 days @ $n each)

Total support for 50 participants

***Total budget***

***Proposed Schedule.***

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| ***Times*** | ***Friday, Oct. 25*** |
| 3:15-3:30 | Judy Walker, Chair Department of Mathematics, University of Nebraska |
| 3:30-4:30 | Martin Bohner |
| 4:30-5:00 | 20-minute talk |
| 5:00-5:30 | 20-minute talk |
| 5:30-6:00 | 20-minute talk |
| 7:00 | Dinner/Reception |

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| ***Times*** | ***Saturday, Oct. 26*** |
| 8:30-9:30 | Ravi Agarwal |
| 9:30-10:00 | Break |
| 10:00-11:00 | Saber Elaydi |
| 11:00-12:30 | Lunch |
| 12:30-1:00 | 20-minute talk |
| 1:00-1:30 | 20-minute talk |
| 1:30-2:00 | 20-minute talk |
| 2:00-2:30 | 20-minute talk |
| 2:30-3:00 | 20-minute talk |
| 3:00-3:30 | Break |
| 3:30-4:00 | 20-minute talk |
| 4:00-4:30 | 20-minute talk |
| 4:30-5:00 | 20-minute talk |
| 5:00-5:30 | 20-minute talk |
| 5:30-6:00 | 20-minute talk |
| 7:00 | Banquet |

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| ***Times*** | ***Sunday, Oct.27*** |
| 8:30-9:30 | Johnny Henderson |
| 9:30-10:00 | Break |
| 10:00-11:00 | John Graef |
| 11:00-11:30 | 20-minute talk |
| 11:30-12:00 | 20-minute talk |