Artificial Intelligence modeling of psychological effects on long-term manned space missions

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Introduction:

With the successful recent launch of the **Orion space mission**, we are at the same point in time for exploring the solar system as we were with the original Mercury space mission in 1962 for exploring the moon. The original Mercury mission was mankind's first step to extra terrestrial space exploration; Orion's deep space missions will be for exploration beyond earth's orbit to other extra terrestrial bodies such as asteroids and eventually to planets such as Mars and beyond. It has long been recognized that space flight impacts the physiology and psychology of humans. There has been extensive research on the physiological effects, however not nearly as much research has been performed on the psychological effects. These effects would be particularly significant for extended space missions. Psychological stress affects the long-term human spaceflight exploration missions which could have potentially serious consequences on the outcome of missions. On earth, gravity played a major role in mankind's evolution. Removal of the gravity from the equation over a long duration space flight could have dramatic effects on the psychological nature of humans.

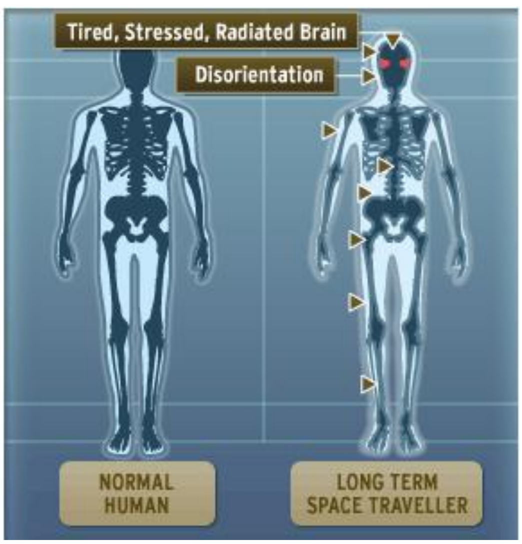

Fig. 1: Figure shows some of the known neurological effects of long-term space flights on the human body.

Long-term isolation, monotony, limited mobility, microgravity, and radiation are known factors impacting humans in manned space missions. These effects are especially significant for long-term missions and have been found to lead to depression, anxiety, insomnia, psychosis and other psychiatric conditions [1].

Project Description:

This proposed research will develop analytic methods to monitor and provide early detection of changes in the psychological status of astronauts as they explore our solar system. It could be detrimental to long-term missions if the stress of space flight impacted Astronauts psychological state. We will use an animal model as a proof-of-principle. Identifying the change in psychological state early would allow intervention before such change could become a serious problem. We are proposing a way to detect the psychological stress at its earliest onset, using artificial intelligence techniques we have developed as applied to other medical applications. Supervised learning and unsupervised learning can be used to classify psychological stress leading to early and non-invasive diagnostic technique to identify stress. Due to the ability of neural networks to identify patterns in complex data, it can be used to recognize patterns and identify and classify electroencephalogram, EEG, data for early diagnosis of psychological stress.

The data to be analyzed will be from rat studies performed at the John L. McClellan Veterans Hospital Research Laboratories. The data is in the form of EEG recordings obtained from both psychologically stressed rats and control rats and will be used to train artificial neural networks to learn the patterns that will be used to classify test data sets. The EEG data in the form of amplitude vs. time will be converted to amplitude vs. frequency (Hz) using Fourier transformation. The transformed data will be used as input by the neural networks to predict and to classify our data. Figure 2 shows a typical complex EEG data with amplitude vs. time and Fourier transformed data with amplitude vs. frequency (Hz). The obtained Fourier transformed data will be used by the neural networks and other AI procedures, to detect and to classify at a very early stage, psychological stressed test subjects vs. normal control subjects. We will use the NASA developed ANN program NETS to accomplish our goal of classifying psychological stress parameters.

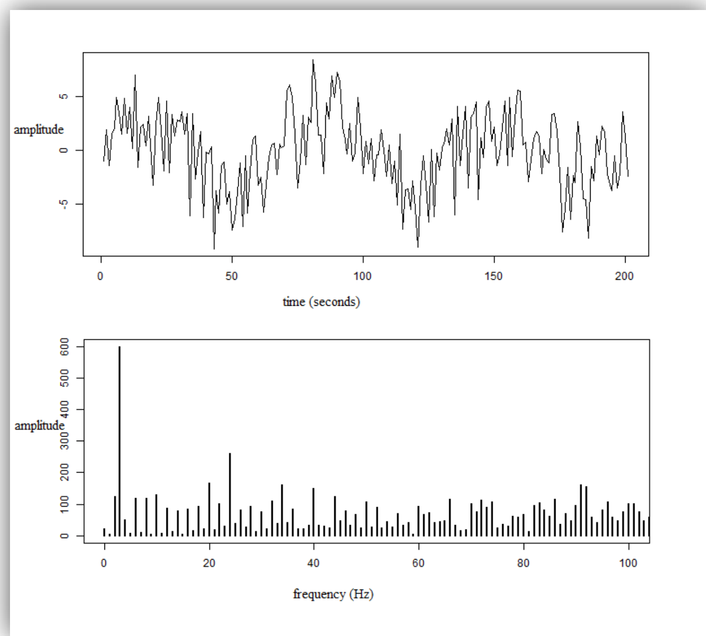

Fig. 2: A typical complex EEG signal (top) showing amplitude vs. time and a Fourier transformed data (bottom) with amplitude vs. frequency (Hz).

Project Purpose:

NASA has devoted much time and funding to understanding the physiological effects of space flight, however much less attention has been devoted to the psychological state of astronauts. This research will attempt to understand the psychological conditions of astronauts and cosmonauts in long term space missions, caused by long term isolation, microgravity, radiation, limited mobility and monotony. The outcome of long term space missions rely on many factors including physical and psychological states of astronauts; identifying this impact early would allow intervention before it becomes a serious problem.

Researchers have conducted NASA funded international studies of psychological and interpersonal issues during on-orbit missions, both crew members and mission control members were studied. The sample involved 13 astronauts and cosmonauts and 58 mission control personnel. The research showed significant evidence for the displacement of tension and negative emotions from the crew members and mission control personnel [1]. This research will attempt to address and identify the psychological changes in the status of astronauts at the earliest stage. Identifying the psychological change of state at the earliest stage will help mission control personnel intervene before a more serious problem develops. This will have a net positive impact on the successful outcome of a long term space mission. In summary is could be stated that the purpose of the project is to identify the psychological conditions of rats and their response to stress by monitoring EEG data, as a proof-of-principle for identifying such changes in the psychological state of astronauts exposed to various stresses.

Goals and Objectives:

The goal of this research is to support the efforts into early detection of psychological response to conditions that can affect the outcome of long term space missions. The proposed research will analyze the EEG data generated from rats as a test model, for studies to be performed at John L. McClellan Veterans Hospital Research Laboratories. The data is in the form of EEG recordings, generated from both psychologically stressed rats and the control group of rats. The generated data will be analyzed with artificial neural networks [ANN] to identify specific patterns that can classify the test group from control group.

Specific objectives:

1. Animal studies;
2. Data filtering and pre processing of EEG data;
3. Fourier transformation of EEG data;
4. Artificial Neural Network training and analysis.

Understanding psychological conditions of astronauts in long term space missions is very important since it can have a major impact on the success of the mission and goals to be achieved during the mission. Due to the ability of neural networks to identify patterns in complex data, it serves as a new and efficient way to identify and classify the psychological status. The data generated from EEG of the rats will have specific patterns that are highly impossible to understand with human eye; however the neural networks can be trained to predict the subtle changes in the brain patterns of EEG recordings due to a response to stress. These subtle changes in the pattern of EEG data will be used to identify and classify the changes in the rat’s behavior. The supervised and unsupervised training techniques of the neural networks will clarify complex data to make predictions on the test data.

Project Content:

Animal Studies:

Male Sprague-Dawley rats (250-270 g, Harlan, Indianapolis, IN) will be housed in a climate controlled room with a 12 hour light dark cycle with food and water as libitum. Studies will be performed while animals are on their light cycle between the times of 7:00 am and 7:00 pm.

Rats at 10–20 weeks of age will be anesthetized with pentobarbital sodium (50 mg/kg i.p.), and fixed in a stereotaxic instrument (David Kopf Instruments, Tujunga, USA) for implantation of EEG electrodes. Small holes will be made in the skull, and screw electrodes will be placed on the surface of the right frontal cortex. Enamel-coated stainless-steel electrodes will be implanted in the hippocampus (3.8 mm caudal and 2.0 mm lateral to the bregma, and 2.2 mm from the cortex surface). A reference electrode will be implanted on the left frontal cranium. The electrodes will then be connected to a miniature plug and fixed to the skull with dental cement. After a 1-week recovery period, animals with chronically implanted electrodes will be placed in a shielded box ($40 \times 40 \times 40$ cm^3). It is within this box that the stress induced states will be measured. Under freely moving conditions, continuous EEG recordings will be made for at least 3 h during daytime (light-on), with behavioural observations made using an amplifier (MEG-6108; Nihon Kohden) and a thermal alley recorder (RTA-1100; Nihon Kohden). The recorded signals will be stored (PowerLab ML845; AD Instruments) for conversion and analysis.

In this project, we wish to induce stressors to the animal that could be similar to those seen by astronauts. For example, the lung is an organ characterized by the presence of periodic mechanical stresses produced by the act of breathing. Thin enough to permit gas exchange; the alveolar–capillary membrane is vulnerable to mechanical deformation from supraphysiological applied forces. *In vitro*, mechanical deformation of pulmonary endothelial and epithelial cells increases the permeability of the cell layer and changes gene expression toward a proinflammatory pattern. In isolated mouse lungs, raising pulmonary vascular pressures resulted in loss of endothelial integrity and high-permeability pulmonary edema.

Inspiratory resistive breathing (IRB) increases the plasma level of proinflammatory cytokines. Strenuous contractions of the inspiratory muscles induce cytokine up-regulation within the diaphragm and when prolonged can injure the respiratory muscles. Strenuous contractions of the inspiratory muscles during resistive breathing lead to large negative swings in intrathoracic pressures and may result in mechanical stress of resident cells in the lung. Although disruption of the alveolar–capillary membrane by applied forces could mediate mechanical stress-induced lung dysfunction, the activation of intracellular pathways (e.g., Src kinase, mitogen-activated protein kinase, and nuclear factor [NF]-κB signaling) by mechanical stress could also participate. Resistive breathing in healthy animals can lead to lung pulmonary epithelial and endothelial barrier dysfunction and can result in acute lung injury and inflammation which should, in turn, alter the EEG of the animal.

For this stressor model, the rats (8–12 wk old) will be anesthetized, tracheostomized, and allowed to breathe through a two-sided valve (Hans Rudolf, Shawnee, KS). Peak inspiratory pressure will be set at 50% of maximum, with the use of a resistance connected at the inspiratory line. Oxygen (100%) will be supplied during the procedure to prevent hypoxemia. The animals will be randomly assigned to 3 or 6 hours of IRB and spontaneously breathing animals that breathed 100% oxygen against no load for equal time periods will serve as controls. The animals used will be those which have had the 1-week recovery period, with chronically implanted electrodes. The 3 to 6 hours of IRB will be done in the shielded box ($40 \times 40 \times 40$ cm^3). It is within this box that the stress induced states will be measured.

For the isolation stressor, following the 1-week recovery period, single animals will be housed in the shielded box for 24, 48, and 72 hours without the ability to see any other animals. The stress induced state will be measured at 8 hour intervals.

Data filtering and pre processing of EEG data:

Pre-processing is a fundamental step in analysis of neurophysiological data; it allows one to clean the data from contaminating artifacts before performing analysis. Stereotyped artifacts and non-stereotyped artifacts including movement of electrodes, current drifts, spurious electrical activity picked by the EEG amplifier and muscle movements will be filtered in the data cleaning process. The data obtained after pre-processing will be used in the next step for Fourier transformation.

The electroencephalogram (EEG) consists of a time series data of evoked potentials resulting from the systematic neural activities in a brain. The recording data of the human EEGs are carried out by placing the electrodes on the scalp, and plotted as voltage magnitude against time [2]. There is similar equipment on a smaller scale, for animal studies, in particular rat studies.

Most of EEG waves range from 0.5-500Hz, however the following four frequency bands are clinically relevant: (i) delta, (ii) theta, (iii) alpha and (iv) beta waves.

Delta waves: Delta waves frequency is up to 3 Hz. It is slowest wave having highest amplitude. It is dominant in infants up to one year and adults in deep sleep.

Theta waves: It is a slow wave with frequency range from 4 Hz to 7 Hz. It emerges with closing of the eyes and with relaxation. It is normally seen in young children and in adults.

Alpha waves: Alpha has frequency range from 7 Hz to 12 Hz. It is most commonly seen in adults. Alpha activity occurs rhythmically on both sides of the head. Alpha wave appears with closing eyes (relaxation state) and disappears normally with opening eyes/stress. It is treated as a normal waveform.

Beta waves: Beta activity is fast with small amplitude. It has frequency range from 14 Hz to 30Hz. It is dominant in patients who are alert or anxious or who have their eyes open. Beta waves usually seen on both sides in symmetrical distribution and is most evident frontally. It is a normal rhythm and observed in all age groups. These mostly appear in frontal and central portion of the brain. The amplitude of the beta wave is less than 30μV [3]

Signal pre-processing is necessary to maximize the signal-to-noise ratio (SNR) because there are many noise sources encountered with the EEG signal. Noise sources can be non-neural (eye movements, muscular activity, 50Hz power-line noise) or neural (EEG features other than those used for control). Further pre-processing will not performed because the purpose is to be as close as possible for real-time applications and further pre-processing would slowdown the process of data analysis.

Fourier transformation of EEG data:

The actual technique, Fourier transformation of EEG data is not a quantification of EEG data but it is reformatting of data into component frequencies. The reformatting of EEG into respective frequencies allows enormous compression in display of data over time, providing easy visualization and analysis of temporal trends.

Discrete Fourier Transformation (DFT) will be applied to the filtered data to transform it from amplitude vs. time data to amplitude vs. frequency data. A computationally efficient procedure of Discrete Fourier Transformation method such as Fast Fourier Transform (FFT) will be applied to the data to reduce the computations needed for the conversion of data from amplitude vs. time to amplitude vs. frequency.

We will perform the Fourier transformation of filtered EEG data using the following equation:

(1)

In a previous effort in a breast cancer project, our group made analysis of ^{31}P spectra data from six patients. Although the acquired spectral data was exceedingly noisy, numerous trial-and-errors made it possible to generate a tentative correlation plot of the experimental results vs. predicted results from the artificial neural network for 6 patients. This was a success since the neural network was in fact, able to "see through the noise" and produce encouraging preliminary results. Figure 3 shows the preliminary results of this study.

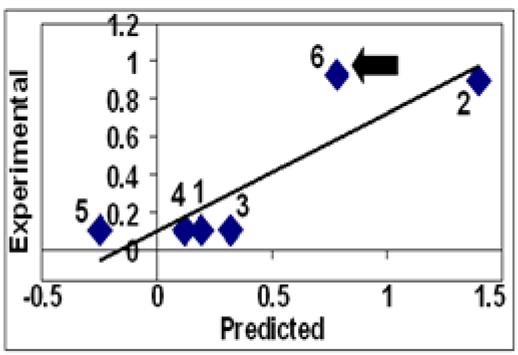

Fig. 3: ANN prediction of malignant breast cancer based on MRI scans of six patients. The arrow indicates a malignant tumor in patient #6.

Artificial Neural Network analysis:

A typical ANN is comprised of processing units or neurons interconnected by weighted signal pathways. Each neuron receives information, either from other neurons, or as input data.

It is made up of a number of inputs called ***input nodes***, a number of processing elements called ***hidden nodes***, and a number of ***output nodes***. There are two main types of artificial neural networks, supervised and unsupervised. A supervised network is presented with both the inputs and the outputs and is expected to construct associations between them [4]. An unsupervised network is used when the outputs are unknown. It is useful in finding similarities or associations in the inputs. The neural network that is used in this study is a supervised, back propagating neural network. The nodes of a feed forward network are interconnected through unidirectional information channels. The output y is given by the nonlinear transformation shown below:

where x_i are the inputs, θ is a node bias, and w_i are the connection weights. A transfer function is used to pass the information from the input layer to the hidden layer. The most commonly used transfer function is the sigmoid function:

This function satisfies the nonlinear differential equation. The result is that a neural network can easily approximate a nonlinear input/output relationship using a series of parallel connections.

The training of ANN consists of repeating cycles of adjusting the connection weights (w_i) between the input, hidden, and output layers using a gradient descent least-squares technique. The goal of these cycles is to decrease the error between the net predicted output and the actual output on which it is training. Once the error reaches a predetermined threshold value, the training is stopped. A validation data set, not used in training or network architecture development, is used to verify the accuracy of the trained ANN model.

ANNs are exceptional at mapping multidimensional space and clarifying complex relationships between inputs and outputs. The network adjusts the weights and propagates the learning process using an equation or learning rule. In theory, a neural network can model any function. ANNs are considered especially useful for modeling systems for which hard and fast rules cannot be easily applied. In clinical medicine, one of the first ANN applications was demonstrated in the analysis of chest pain of patients admitted in the emergency room [5, 6]. Figure 4 shows a typical artificial neural network with input data and output correlation plot.

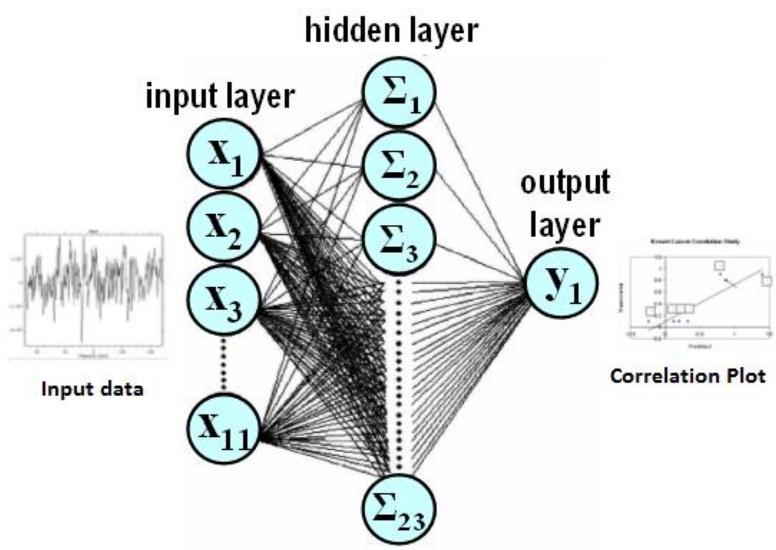

Fig. 4: A typical back-propagation artificial neural network with input data and output correlation plot.

Anticipated Results:

The long term goal of this research will be in the form of potential markers that can classify and identify changes in the psychological conditions of astronauts during long term space missions, such as goal of the Orion project. The results will serve as an important step in identification of changes in the psychological conditions at the earliest stage, and can potentially impact the mission and outcome of the long term space missions. It is highly desirable to develop a new, efficient way to detect psychological states of astronauts as they explore our solar system.

The results will be in the form of predictions regarding previously determined bio-markers, related to the data from EEG recording and will be in the form of an easily interpretable graph with predicted and experimental values on x and y axes in the form of a correlation plot. The results will serve as potential markers to identify psychological conditions in astronauts from their EEG recordings.

Partnership and Interactions:

We have collaborations with two institutions for the proposed research work; John L. McClellan Veterans Hospital and University of Arkansas at Pine Bluff. Dr. Sue Theus, Deputy Associate Chief of Research at John L. McClellan Veterans Hospital will be performing the animal studies experiments. We have ongoing collaboration with this Little Rock Veterans Hospital Research Laboratory for at least 5 years, and we have partnered with this Veterans Hospital in several previous research projects. One of our completed previous research projects at this facility was entitled “The Determination of Cardiac Surgical Risk using Artificial Neural Networks” and resulted in a high impact publication and presentation at a medical conference, and published in the conference proceedings.

Our second partner is with the University of Arkansas at Pine Bluff [UAPB]. UAPB is an academic institution, is a historical minority institution and is the second oldest public institution in Arkansas. Dr. Karl Walker, Assistant professor of Computer Science is performing data pre processing and data dredging tasks. Dr. Karl Walker is a new faculty member, a Bioinformatics PhD graduate from University of Arkansas at Little Rock/ University of Arkansas for Medical Sciences. The extraordinary data mining and data pre processing skills of Dr. Karl Walker and exceptional experimental research skills of Dr. Sue Theus will aid us in the proposed research project.

Timeline:

Statement of Work with Timeline

Specific Objectives (specified in proposal)	**Timeline**	**Site 1(UALR)**	**Site 2 (John L. McClellan Veterans Hospital)**	**Site 3 (UAPB)**
Major task 1: Animal Experimental Studies	**Months**			
Obtaining total rats for the experimental studies	1-3		Dr. Sue Theus	
Preparing rats fro EEG studies	1-3		Dr. Sue Theus	
Obtaining data from the rats using EEG electrodes	3		Dr. Sue Theus	

Local IRB/IACUC Approval	3			
Major task 2: Data pre processing				
Identification of artifacts	2			Dr. Karl Walker
Removing noise	2			Dr. Karl Walker
Normalization of data	2			Dr. Karl Walker
Major task 3: Fourier Transformation				
Algorithm development	2	Dr. Jerry Darsey		
Implementation	2	Dr. Jerry Darsey		
Discrete Fourier transform	2	Dr. Jerry Darsey		
Major task 4: Artificial Neural Network Analysis				
Training the neural networks	3	Dr. Jerry Darsey		
Test data	3	Dr. Jerry Darsey		
Analysis of data with ANN	3	Dr. Jerry Darsey		

Sustainability:

This research has a high potential impact of identification changes in the psychological conditions of astronauts at the earliest possible stage of change, during long duration space missions, such as those planned for the Orion space project. The research capabilities of this proposed research will be used to support the efforts and missions of NASA as they plan for extended space flights.

A future potential research project will involve the idea of studying **Traumatic Brain Injuries** (TBI). Traumatic brain injury (TBI), also known as **intracranial injury**, occurs when an external force traumatically injures the brain. TBI can be classified based on severity, mechanism (closed or penetrating head injury), or other features (e.g., occurring in a specific location or over a widespread area). *Head injury* usually refers to TBI, but is a broader category because it can involve damage to structures other than the brain, such as the scalp and skull [7]. TBI can be very difficult to diagnose. The neuropsychological assessment is a specialized task-oriented evaluation of human brain-behavior relationships. It relies upon the use of standardized testing methods to evaluate higher cognitive functioning as well as basic sensory-motor processes. It is appropriate for both a neurologist and a neuropsychologist to perform evaluations and there are some similarities to the kind of testing they do; however, the neuropsychological assessment is designed to provide more detailed and comprehensive information about cognitive capabilities than the neurological evaluation [7]. We feel that our procedures, which will be used to identify changes in the psychological state of astronauts, can also provide a reliable method to diagnose TBI at a very early stage. This will have an enormous impact with troops injured in a combat situation, a football player hit during a game, a person injured in an automobile (or other vehicle) accident, etc.

Dissemination:

The results obtained will be presented at high impact scientific conferences and will be published in broader, high impact journals such as the appropriate neurological medical journals; for example *The Journal of the Neurological Sciences*, *BMC Neurology*, etc. In addition, results will be presented at conferences to disseminate the research results of this project. Where appropriate, the non-classified results and broader aspects of the research work will also be presented to non-scientific publications such as the *Arkansas Democrat-Gazette* newspaper. We will consider other professional and scholarly journals, magazines, newspapers and conference proceedings, to disseminate this research. The best research venue for research presentations will be selected to impact the outreach of the research project to selected appropriate target audiences.

References:

1. Bechtel, R.B., Berning, A. [1991]. The third-quarter phenomenon: Do people experience discomfort after stress has passed? In: A.A. Harrison, Y.A. Clearwater, C.P., McKay. From Antarctica to Outer Space. New York: Springer.
2. Sinha RK, EEG power spectrum and neural network based sleep hypnogram analysis for a model of heat stress. J Clin Monit Comput [2008]; 22:261–268
3. Saeid Sanei and J.A. Chambers, EEG Signal Processing, John Wiley and Sons Ltd, England, [2007].
4. S.L Parker, Tong, T., Bolden, S, et al.: Cancer statistics, 1996. *Ca-A Cancer Journal for Clinicians*, *46*(1): 5-27, [1996].
5. G. M. Boratyn, T. G. Smolinski, J. M. Zurada, M. G. Milanova, S. Bhattacharyya, L J Suva: “Hybridization of Blind Source Separation and Rough Sets for Proteomic Biomarker Indentification”, [ICAISC 2004: 486-491].
6. Suva, L J, Brander BE, Makhoul I. Cancer: Update on bone-modifying agents in metastatic breast cancer. Nat Rev Endocrinol. 7:380-381, 2011 [Epub 2011 May 24] PMID: 21610686.

7. Brain Injury Association, *National Brain Injury Information Center*, http://www.biausa.org/brain-injury-diagnosis.htm, "Diagnosing Brain Injury", [2014]

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Sue A. Theus, Ph.D.	Deputy Associate Chief of Staff, Director, Biosafety Level III Laboratory
eRA COMMONS USER NAME SATHEUS	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
University of Arkansas, Fayetteville, AR	B.S.	1985	Animal Science;
University of Arkansas for Medical Sciences,	Ph.D.	1989	Biochemistry and Molecular Biology

A. Positions and Honors

2010-Present Deputy Associate Chief of Staff/Research, Central Arkansas Veterans Healthcare System, Little Rock, Arkansas

2006-2010 Director, Biosafety Laboratory 3, Supervisor, Veterinary Medical Unit, Health Science Officer, Central Arkansas Veterans Healthcare System, Little Rock, Arkansas

2002-2005 Assistant Professor, Department of Pathology, University of Arkansas for Medical Sciences, Little Rock, Arkansas, Director, Biosafety Laboratory 3, Central Arkansas Veterans Healthcare System, Little Rock, Arkansas

1994-1998 Instructor, Division of Infectious Disease, Department of Internal Medicine, University of Cincinnati, Cincinnati, Ohio

1992-1994 Postdoctoral Fellow, Division of Infectious Disease, Department of Internal Medicine, University of Cincinnati, Cincinnati, Ohio

1991-1992 Instructor, Department of Microbiology, University of Arkansas for Medical Sciences, Little Rock, Arkansas

1989-1991 Postdoctoral Fellow, Dept of Microbiology, University of Arkansas for Medical Sciences, Little Rock, Arkansas

Professional Memberships:
American Society for Microbiologists, American Association for Laboratory Animal Science, Scientist Center for Animal Welfare, American Thoracic Society

B. Selected Publications

1. Ding, Z., Liu, S., Wang, X., **Theus, S**., Mehta, J. 2014. LOX-1-dependent mitochondrial DNA dmage and NLRP3 activiation during systemic inflammation in mice. Biochem Biophys Res Commun., 451(4):637-643.
2. Boddu, NJ, **Theus, S**, Luo, S, Wei, J, and Ranganathan, G. 2014. Does adiponectin exert a protective effect in response to ER/SR stress in the heart? Cardio. In press.
3. Li, S., Megyesi, J., Shank, B., **Theus, S**. Price, P, Portilla, D. 2013. Proximal tubule PPARa attenuates renal fibrosis and inflammation caused by unilateral ureteral obstruction. Am J Physiol Renal, 305(5):618-27.
4. Lee, EA, **Theus, SA** 2012. Lower heart rate variability associated with military sexual trauma rape and posttraumatic stress disorder. Biol Res Nurs 14(4):412-418.
5. Helms, SA, Azhar, G, Zuo, C, **Theus, S,** Wei, JY 2010. Smaller cardiac cell size and reduced extra-cellular collagen might be beneficial for hearts of Ames dwarf mice. Int J Biol Sci, 6(5):475-490.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
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NAME	POSITION TITLE
Karl A. Walker, Ph.D.	Assistant Professor
eRA COMMONS USER NAME	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Morehouse College, Atlanta, GA	B.S.	2002	Computer Science
University of Arkansas at Little Rock; University	M.S. Ph.D.	2010 2014	Bioinformatics Bioinformatics

A. Positions and Honors

2014-Present Assistant Professor, University of Arkansas at Pine Bluff, Pine Bluff, Arkansas

2014 First Place, Oral Presentation, Mid-south Computational Biology & Bioinformatics Society, MCBIOS

2010-2011 Outstanding MS Graduate, College of Engineering and Information Technology, University of Arkansas at Little Rock

2010-2011 Outstanding Bioinformatics Masters Student, UALR/UAMS Bioinformatics Graduate Program
2009-2014 Southern Regional Education Board State Doctoral Scholars Fellow

B. Selected Publications

1. New enumeration algorithm for protein structure comparison and classification, C. Ashby, D. Johnson, **K. Walker**, I. A. Kanj, G. Xia, X. Huang, *BMC Genomics*, vol 14, s2, 2013

2. TERPRED: A dynamic structural data analysis tool, **K. Walker**, C. Cramer, S. Jennings, and X. Huang, Recent Advances in Computer Science and Information Engineering, *Lecture Notes in Electrical Engineering* 125, No. 2, page 781-786, 2012

3. Gene expression analysis using BOWTIE alignment and RPKM normalization, M.P. Hardin, D. Johnson, **K. Walker**, C. Ashby and X. Huang, Poster Presentation at the NSF Bioinformatics Workshop, 2013.

4. Analysis of Transcription Factor Expression Level Change in Tomato and Arabidopsis, P. Hardin, D. Johnson, A. De La Cruz, **K. Walker**, C. Ashby, S. Grace, V. Srivastava and X. Huang, Poster at ASTA annual meeting, Fayetteville, 2012

5. A Complete 180: A Second Look at Omega Torsion Angles, **K. Walker**, J. Darsey, X. Huang, S. Jennings, Student Research Expo, University of Arkansas at Little Rock, Little Rock, Arkansas, April 4, 2011.

BIOGRAPHICAL SKETCH—JERRY A. DASEY

EDUCATION AND TRAINING		
Louisiana State University, Baton Rouge, Louisiana, USA	Physics Mathematics	BS 1970
Louisiana State University, Baton Rouge, Louisiana, USA	Physical Chemistry Nuclear Science	PhD 1982

Research and Professional Experience

1984 - 1988 Assistant Professor of Chemistry, Tarleton State University, Texas A&M University System, Stephenville, TX, USA

1988 - 1990 Associate Professor of Chemistry, Tarleton State University, Texas A&M University System, Stephenville, TX, USA

1990 - 1993 Assistant Professor, Department of Chemistry, University of Arkansas at Little Rock, AR, USA

1993 - 1995 Associate Professor and Professor of Chemistry Joint Appointment, Department of Biopharmaceutical Sciences, University of Arkansas for Medical Sciences, AR

1993 - 1996 Associate Professor, Department of Chemistry, University of Arkansas at Little Rock, AR, USA

2002 -2012 Consultant, National Center for Toxicological Research, FDA, Jefferson, AR, USA

1996 - current Professor, Department of Chemistry, University of Arkansas at Little Rock, AR, USA with joint appointments in Department of Applied Sciences and Biopharmaceutical Sciences, University of Arkansas for Medical Sciences, AR

Relevant Publications

(Publications selected from ≈120 peer-reviewed publications)

1. Darsey J. A., Theoretical Aspects and Computer Modeling of the Molecular Solid State. Edited by Angelo Gavezzotti (University of Milan, Italy). John Wiley & Sons, New York, (1997) 237. ISBN 0-471-96187-6.701-708.
2. Darsey J.A., Lay J.O., Holland R.D.. Deconvolution of Composite Mass Spectra Using Artificial Neural Networks*" Int. J. of Chem. and Biotechnol.,* 17, No. 9, 41 2001.
3. Darsey J.A., B. G. Sumpter, D. W. Noid, "Correlating Physical Properties of Both Polymeric and Energetic Materials and their Organic Precursors of Polymers Using Artificial Neural Networks", *Int. J. of Smart Engineering Sys. Design* , 2, 283, (2000).
4. Darsey J. A. Applications of Artificial Neural Networks to Materials. *Encyclopedia of Smart Materials*, 2 Vol.; Schwartz, Mel. Ed; John Wiley, N.Y. June, 2002.
5. Darsey J.A., Modeling Smart Materials using Neural Networks, Encyclopedia of Smart Materials, 2 vol set; Schwartz, Mel. Ed, John Wiley, New York, March, 2002, pp 682-690.
6. W.O. Griffin and J. Darsey, "Modeling Transition Metal Nanoclusters for Hydrogen Storage Capacity Using Artificial Neural Networks" Intelligent Engineering Systems through Artificial Neural Networks Vol. 17, Ed. Cihan H. Dagli, p. 593-598 (2007).
7. Darsey, J.A. ,Dan A. Buzatu,"Computational Design and Analysis of Nanosize Electronic Components and Circuits" *in Handbook of Theoretical and Computational Nanotechnology*, (2006).
8. W.O. Griffin and J.A. Darsey, "Bulk Metallic System Modeling of Metal Hydride Dimer and Trimer Nanoclusters" J. Comp. Theor. Nanoscience 7, 1-6, (2010).

Synergistic Activities: Professional Activities

1986	Visiting Assistant Professor of Chemistry, Oklahoma State University, Stillwater, OK, USA
1986	Visiting Associate Professor of Chemistry & Physics, Physics Dep., Virginia Commonwealth University, Richmond, VA, USA
1986 - 1990	Consultant, Oak Ridge National Laboratory, Oak Ridge, TN, USA
1987 - 1988	Visiting Associate Professor of Chemistry, Cornell University, Ithaca, NY , USA
1986 -	Member, American Chemical Society (Polymer Division)
1986 -	American Physical Society (Forum on Education in Science and Engineering, High Polymer Physics Division, Chemical Physics Division
1989	American Association for the Advancement of Science
1990	The Arkansas Academy of Sciences
1990	Society of Plastic Engineer

Synergistic Activities: Patents (total patents 7)

1. Apparatus and Methods of High Throughput Generation of Nanostructures by Inductive Heating and

Improvements of Productivity while Maintaining Quality and Purity, 60-571999, 2004
2. Surface Modified Single Walled Carbon Nanotubes Optical Sensors and Methods of Manufacturing. 8-202004, 2004
3. Apparatus and Methods for Synthesis of Large Size Batches of Carbon Nanostructures. 60-611018, 2004
4. Nanotube-Porphyrin Molecule Compounds and photovoltaic and circuit applications, 60-609506, 2005
5. Production of Carbon Nanostructures by Curie Point Heating, 60-638243, 2005

Professional Activities

1. Chairman, 1st American Physical Society Symposium on the Applications of Artificial Neural Networks and Other Artificial Intelligence Procedures to Chemical Systems, National Meeting of the American Physical Physical Society, San Jose, CA.1995.
2. Who's Who in Plastics and Polymers,1st Ed., Society of Plastics Engineers, 2000.
3. Selected by the International Biographical Center in Cambridge England, that he has been included in the 2000 Eminent Scientist of Today, First Edition. May, 2001.
4. NASA AMES Research Center Seminar, Palo Alto, CA "Computational Studies of Nanodimensional Molecules", Palo Alto, CA, 2001.
5. National Meeting of the American Chemical Society, Prediction of Toxic Equivalency Factors for Dioxins, Furans and PCB's Using Artificial Neural Networks, 2002
6. Editorial Board, Journal of Computational and Theoretical Nanoscience, appointed 2004.
7. Artificial Intelligence Modeling of FDA/National Center for Molecular and Biomolecular System's Toxicological Research, 2004
8. Who's Who in Science and Mathematics, Marquis Publications, New York, 2002-2014.
9. Who's Who in the World, Marquis Publications, New York , 2004-2014
10. Artificial Intelligence Modeling of Materials Bulk Chemical and Physical Properties, IPSI International Conference on Interdisciplinary Research, 2005.

Potential Conflicts of Interest:

Graduate and Postdoctoral Advisor: Neil Mitchell, M.S.; Sushma Thotakura, M.S.; Billy Griffin, PhD Philip Williams; PhD; Kimberly Taylor; PhD; Bryan Fox, M.S.; Amber Climer, M.S.; Kirk Babb, M.S.; James Sumpter, M.S; Diana Lindquist, PhD; Shashi Vyas, M.S.; Regan Cole, PhD; Gene Bangs, PhD; Amit Shah , MS; Wei Li, PhD; Aiman Akila, M.S.; Ahmed Saleh, M.S.; Xiaomin (Helen) Tu, M.S.; Elizabeth Geesaman, M.S.; Judy Ingram , M.S.; Yuan Dai, M.S.; Qing Luo, M.S.; Tom Ezell, M.A.; Venkat Mylarampu, M.S.; Arvin Narayanaswany**,** M.S. **;** Ashish Soman, M.S.; Piere Alusta, PhD; Rauf Razzaq, Post Doc.

Collaborators: Abul Kazi, PhD Chemistry Dept. University of Arkansas at Pine Bluff (870) 575-8979; kazia@uapb.edu; Grover Miller, PhD UAMS (501-526-6486); millergroverp@uams.edu; Bernard Chen, PhD, Computer Science Dept. University of Central Arkansas Puru Jena, PhD Physics Dept., Virginia Commonwealth University:(804)828 8991;pjena@vcu.edu; Robert Shelton, PhD Johnson Space Center, NASA; robert.o.shelton@nasa.gov**;** Bobby Sumpter, PhD Computational Division, Oak Ridge National Laboratory, Oak Ridge, TN: sumpterbg@ornl.gov; Allison Harris, PhD Physics Dept., Illinois State, University, alharri@ilstu.edu; Peiyi Tang, PhD, Computer Science, University of Arkansas at Little Rock. pxtang@ualr.edu; Jane (Xian) Yu, PhD Department of Mathematics, University of Arkansas at Little Rock. xxyu@ualr.edu; Brian Berry, PhD Department of Chemistry, Universityof Arkansas at Little Rock bcberry@ualr.edu; Darin E. Jones PhD Department of Chemistry, University of Arkansas at Little Rock, dejones@ualr.edu Tansel Karabacak,PhD Department of Applied Science, University of Arkansas at Little Rock. txkarabacak@ualr.edu**;** Anindya Ghosh,PhD Department of Chemistry, University of Arkansas at Little Rock,axghosh@ualr.edu Kenji Yoshigoe, PhD Department of Computer Science, University of Arkansas at Little Rock kxyoshigoe@ualr.edu; Chunshan Li, PhD Institute of Process Engineering, Chinese Academy of Sciences,Beijing, China,100190 csli@home.ipe.cn; William Zimmerman,PhD Chemical and Biological Engineering, University of Sheffield,United Kingdom w.zimmerman@sheffield.ac.uk

	Budget for NASA:EPSCoR Project: Darsey;Berry;Harris;Kazi			NASA EPSCoR	UALR Match	NASA EPSCoR	UALR Match	NASA EPSCoR	UALR Match	NASA EPSCoR	UALR Match
				Year 1	Year 1	Year 2	Year 2	Year 3	Year 3	**Total**	**Total**
A	**Senior Personnel**		**Annual Salary**								
	Darsey, Jerry PI, 2 person-months summer salary+25% release time		$78,057	$17,346	$31,503	$17,866	$32,448	$18,313	$33,402	$53,525	$97,352
	Walker, Karl Co-PI n/a sub contract			$0	$14,125	$0	$14,549	$0	$14,985	$0	$43,659
	Theus, Sue Co-PI n/a sub-contract			$0	$34,193	$0	$35,219	$0	$36,275	$0	$105,687
	Post-Doc (to be named)	1	$40,000	$40,000	$8,520	$41,200	$8,776	$42,436	$9,039	$123,636	$26,334
	Total			**$57,346**	**$88,341**	**$59,066**	**$90,991**	**$60,749**	**$93,701**	**$177,161**	**$273,033**
B	GRADUATE STUDENTS [2 paid by NASA grant, 1 paid by college]	3	$18,000	$36,000	$33,318	$37,080	$34,318	$38,192	$35,347	$111,272	$102,983
	UNDERGRADUATE STUDENTS	2	$5,000	$10,000	$2,130	$10,000	$2,130	$10,000	$2,130	$30,000	$6,390
	TOTAL (Students)			**$46,000**	**$35,448**	**$47,080**	**$36,448**	**$48,192**	**$37,477**	**$141,272**	
C	**Fringes**			$15,482	$3,298	$15,923	$3,392	$16,360	$3,485	$47,765	$10,174
	Licence renewal for computer software		$2,500	$2,500	$1,063	$2,500	$1,063	$2,500	$1,063	$7,500	
	Computer Resources Provided by UALR			$0	$5,000	$0	$5,000	$0	$5,000		$15,000
	Travel										
D	Domestic travel for research groups to attend meetings			$5,000		$5,000		$5,000		$15,000	
	Foreign			$0		$0		$0		$0	
	TOTAL Travel			**$5,000**	**$2,125**	**$5,000**	**$2,125**	**$5,000**	**$2,125**	**$15,000**	
										$0	
	Other Direct Costs										
E	Materials and Supplies			$5,000	$2,125	$5,000	$2,125	$4,539	$1,929	$14,539	$6,179
	Publication cost for journal articles and dissertations			$2,000	$850	$2,000	$850	$2,000	$850	$6,000	$2,550
	3. Software for new AI programs			$2,000	$850	$2,000	$850	$2,000	$850	$6,000	$2,550
	4. Computer Server	1	5000		$7,125	$0		$0			$7,125
	5. Subawards(University of Arkansas at Pine Bluff/Karl Walker)			$20,000	$8,500	$20,000	$2,125	$20,000	$0	$60,000	$10,625
	Subaward/VA Sue Theus			$10,000	$4,250	$10,000	$4,250	$10,000	$2,125	$30,000	$10,625
	7. Other - Tuition, and fees for graduate student including $1000 health insurance	3	6700	$20,100		$20,703		$21,324		$62,127	
	TOTAL Other Direct cost			$59,100		$59,703		$59,864		$178,667	
	TOTAL DIRECT COSTS			**$185,428**		**$189,272**		**$192,665**		**$567,365**	
F	Base for calculating indirect										
	INDIRECT COSTS			$25,192	$150,999	$25,879	$149,217	$26,564	$148,605	$77,634	$448,821
	TOTAL INDIRECT AND DIRECT COSTS			**$210,620**		**$215,151**		**$219,229**		**$645,000**	
G									**Total for Project------**		**$1,093,820**

RATES		
indirect costs		0.212
fringe summer salary		0.18
fringe regular salary		0.28
tuition/insurance		6700
fringe grad ast.		0.01
feing undergraduate		0.08
inflation		0.03

Justification of Budget ($210,620, Direct Cost and $150,999, UALR match) Year 1:

1. The PI is requesting $17,346 for year one for 2.00 person-months summer salary with $31,503 match, which includes 25% research time and includes the difference between 42.5% and 21.2%(maximum allowed by NASA) indirect.
2. The Co-PI, Sue Theus, is providing 25% of her time as match, which comes to $34,193.
3. The Co-PI, Karl Walker, is providing 25% of his time as match, which comes to $14,125.
4. The grant is requesting $40,000 for year one for a post-doctoral associate with $8,520 match which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
5. We are requesting $36,000 as a research stipend for two (2) PhD graduate students for year one paid by NASA. Matching funds include $18,000 for one graduate student provided by UALR and includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
6. We are requesting $10,000 for stipend for two (2) undergraduate students with a match OF $2,130 provided UALR which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
7. We are requesting $15,482 in year one for fringe benefits for the PI at 18%, post doc at 28%, two graduate students at 1% and two undergraduate students at 8% and a match of $3,298 which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
8. We are requesting $2,500 for license renewal for computer software and a match of $1,063 which includes 42.5% of indirect.
9. A request of $5,000 for computer resources and computer time which is provided by UALR as a match of CPU time for computer resources.
10. A request of $5,000 for domestic travel to meetings to present research and report on progress and $2,125 as a match from UALR which includes 42.5% indirect.
11. We are requesting $5,000 for materials and supplies and $2,125 as a match, which includes 42.5% of the indirect.
12. A request of $2,000 for publication costs, journal articles, and dissertations and $850 as a match, which includes 42.5% of the indirect.
13. We are requesting $2,000 for software and new AI programs and a match of $850, which includes 42.5% of the indirect.
14. We are requesting $5,000 for computer server, and a match of $7,125 (includes $5,000 and 42.5% of indirect costs).
15. We are requesting $20,000 for sub awards for Co-PI, Karl Walker (UAPB) and a match of $8,500, which includes 42.5% of the indirect costs.
16. We are requesting $10,000 for sub awards for Co-PI, Sue Theus (VA) and a match of $4,250, which includes 42.5% of the indirect costs.
17. We are requesting $20,100 for three (3) graduate students which include $5,700 for tuition and $1,000 for health insurance for each student.

Justification of Budget ($215,151, Direct Cost and $149,217, UALR match) Year 2:

1. The PI is requesting $17,866 (includes 3% increase for inflation) for year two for 2.00 person-months summer salary with $32,448 match (includes a 3% increase for inflation), which includes 25% research time and includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
2. Co-PI, Sue Theus, is providing a match of $35,219 for year two, which includes 3% increase for inflation.
3. Co-PI, Karl Walker, is providing a match of $14,549 for year two, which includes 3% increase for inflation.

4. We are requesting $41,200 for post doctoral associate (which includes 3% increase for inflation) for year two and $8,766 match, which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
5. We are requesting $37,080 for year two for two graduate students which includes 3% increase for inflation and $34,318 match which includes one graduate student and 21.3% indirect.
6. We are requesting $10,000 for year two for two undergraduate students and a match of $2,130 includes 21.3% indirect.
7. We are requesting $15,923 in year two for fringe benefits for the PI at 18%, post doc at 28%, two graduate students at 1% and two undergraduate students at 8% and a match of $3,392 which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
8. We are requesting $2,500 for license renewal for computer software and a match of $1,063 which includes 42.5% of indirect.
9. A request of $5,000 for computer resources and computer time which is provided by UALR as a match of CPU time for computer resources
10. A request of $5,000 for domestic travel to meetings to present research and report on progress and $2,125 as a match from UALR which includes 42.5% indirect.
11. We are requesting $5,000 for materials and supplies and $2,125 as a match, which includes 42.5% of the indirect.
12. A request of $2,000 for publication costs, journal articles, and dissertations and $850 as a match, which includes 42.5% of the indirect.
13. We are requesting $2,000 for software and new AI programs and a match of $850, which includes 42.5% of the indirect.
14. We are requesting $20,000 for sub awards for Co-PI, Karl Walker (UAPB) for year two and a match of $2,125, which includes 42.5% of the indirect costs for $5,000.
15. We are requesting $10,000 for sub awards for Co-PI, Sue Theus (VA) for year two and a match of $4,250, which includes 42.5% of the indirect costs.
16. We are requesting $20,703 for three (3) graduate students for year two which includes 3% increase for inflation.

Justification of Budget ($219,229, Direct Cost and $148,605, UALR match) Year 3:

1. The PI is requesting $18,313 (includes 3% increase for inflation) for year three for 2.00 person-months summer salary with $33,402 match (includes a 3% increase for inflation), which includes 25% research time and includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
2. Co-PI, Sue Theus is providing a match of $36,275 for year three, which includes 3% increase for inflation.
3. Co-PI, Karl Walker is providing a match of $14,985 for year three, which includes 3% increase for inflation.
4. We are requesting $42,436 for post doctoral associate (which includes 3% increase for inflation) for year three and $9,039 match, which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
5. We are requesting $38,192 for year three for two graduate students which includes 3% increase for inflation and $35,347 match which includes one graduate student and 21.3% indirect.
6. We are requesting $10,000 for year three for two undergraduate students and a match of $2,130 includes 21.3% indirect.
7. We are requesting $16,360 in year three for fringe benefits for the PI at 18%, post doc at 28%, two graduate students at 1% and two undergraduate students at 8% and a match of $3,485 which includes the difference between 42.5% and 21.2% (maximum allowed by NASA) indirect.
8. We are requesting $2,500 for license renewal for computer software and a match of $1,063 which includes 42.5% of indirect.

9. A request of $5,000 for computer resources and computer time which is provided by UALR as a match of CPU time for computer resources
10. A request of $5,000 for domestic travel to meetings to present research and report on progress and $2,125 as a match from UALR which includes 42.5% indirect.
11. We are requesting $4,539 for materials and supplies and $1,929 as a match, which includes 42.5% of the indirect.
12. A request of $2,000 for publication costs, journal articles, and dissertations and $850 as a match, which includes 42.5% of the indirect.
13. We are requesting $2,000 for software and new AI programs and a match of $850, which includes 42.5% of the indirect.
14. We are requesting $20,000 for sub awards for Co-PI, Karl Walker (UAPB) for year three.
15. We are requesting $10,000 for sub awards for Co-PI, Sue Theus (VA) for year two and a match of $2,125, which includes 42.5% of the indirect costs for $5,000.
16. We are requesting $21,324 for three (3) graduate students for year three which includes 3% increase for inflation.

Total Direct costs: $567,365

Total Indirect costs: $77,634

Total Direct and Indirect costs: $645,000

Total UALR match: $448,821

Total Project costs: $1,093,820

DEPARTMENT OF VETERANS AFFAIRS
Central Arkansas Veterans Healthcare System
4300 West 7th Street
Little Rock AR 72205

January 12, 2015

Sue Theus, PhD
Deputy Associate Chief of Staff
Research Health Scientist
Central Arkansas Veterans Healthcare System
Research Service
Little Rock, Arkansas 72205

RE: Commitment letter for the grant "Artificial Intelligence modeling of psychological effects on long term manned space missions"

Dear Dr. Darsey,

It is my pleasure to write a letter of commitment for the grant proposal "Artificial Intelligence modeling of psychological effects on long term manned space missions" which will use Artificial Intelligence techniques to detect psychological stress at the earliest onset in rats.

As you are aware, I have an active research program on vaccine development on *Pneumocystis carinii,* and another on the characterization of various virulent strains of *M. Tuberculosis* at CAVHS. My laboratory has more than 22 years of experience in the experimental use of rats. Moreover, this is in addition to my position as Veterinary Medical Unit Supervisor at CAVHS.

I shall be happy to assist you with the animal experimental design and execution of your grant-related experiments. I am able to commit 25% of my time to this project.

Sue Theus, PhD
501-257-4841
Sue.theus@va.gov

UNIVERSITY of ARKANSAS AT PINE BLUFF

1873

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

Dr. Keith Hudson.
Director
NASA EPSCoR
University of Arkansas at Little Rock
Little Rock, AR 7220

January 15, 2015

Dear Dr. Hudson:
As Chairperson of the Department of Mathematical and Computer Sciences, I am writing to give my support for the Artificial Intelligence Modeling of Psychological Effects on Long Term Manned Space Missions.

The project will greatly enhance the financial resource available to our students within the Department. In addition, the proposed project will provide unique opportunities to our students in high-level mathematics/computer science courses to enrich their understanding of their STEM discipline.

If this project is funded, the Department of Mathematics and Computer Sciences will provide release time for Dr. Karl Walker equal to 25% each academic semester in the form of one course release per semester.

The department is committed to ensuring that the activities proposed in this project are successful at the University of Arkansas at Pine Bluff. The department will provide any necessary recourses or support services to ensure its activities are successful.

In addition, I believe the proposed project would be an outstanding asset to our department, and the University of Arkansas at Pine Bluff.

Sincerely,

Jessie J Walker, Ph.D.
Interim Chairperson
Department of Mathematics and Computer Science

1200 N. University Drive, Mail Slot 4945 Pine Bluff, AR 71601
Office (870) 575-8774 Fax (870) 575-8776 Email: cs@uapb.edu
cs.uapb.edu

UALR

OFFICE OF THE VICE PROVOST FOR RESEARCH/
DEAN OF GRADUATE SCHOOL

January 8, 2015

NASA EPSCoR
Attention: Dr. M. Keith Hudson
University of Arkansas at Little Rock

Dear Dr. Hudson:

The University of Arkansas at Little Rock supports the collaborative proposal of Dr. Jerry Darsey of UALR, Dr. Sue Theus of the Department of Veterans Affairs, Central Arkansas Healthcare System, Dr. Karl Walker of UAPB, and Dr. Robert Shelton of the NASA Johnson Space Center in the project titled "Artificial Intelligence modeling of psychological effects on long term manned space missions." As part of our support for this project UALR will provide Dr. Darsey an HPC computing workstation which will cost approximately $5,000.00.

Sincerely,

Paula Casey

Paula Casey
Interim Vice Provost for Research

UNIVERSITY OF ARKANSAS AT LITTLE ROCK
2801 South University Avenue   Little Rock, Arkansas 72204-1099
(O) 501.569.8656   (F) 501.569.3039

UALR

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DEAN OF GRADUATE SCHOOL

January 8, 2015

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Sincerely,

Paula Casey
Interim Vice Provost for Research

DEPARTMENT OF VETERANS AFFAIRS
Central Arkansas Veterans Healthcare System
4300 West 7th Street
Little Rock, Arkansas 72205

In Reply Refer To: 598/152/NLR

January 13, 2015

Jerry Darsey, PhD
Professor, Department Of Chemistry
University of Arkansas at Little Rock
2801 S. University Ave.
Little Rock, AR 72204

RE: Commitment letter for the grant “Artificial Intelligence Modeling of Psychological Effects on Long Term Manned Space Missions”

Dear Dr. Darsey,

Dr. Sue Theus will commit 25% of her time to the proposed grant, “Artificial Intelligence Modeling of Psychological Effects on Long Term Manned Space Missions.” CAVHS salary commitment will be $34,193.

Sincerely,

Richard R. Owen, MD
Associate Chief of Staff for Research
Central Arkansas Veterans Healthcare System

UNIVERSITY
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1873

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

Dr. Keith Hudson.
Director
NASA EPSCoR
University of Arkansas at Little Rock
Little Rock, AR 7220

January 15, 2015

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In addition, I believe the proposed project would be an outstanding asset to our department, and the University of Arkansas at Pine Bluff.

Sincerely,

Jessie J Walker, Ph.D.
Interim Chairperson
Department of Mathematics and Computer Science

1200 N. University Drive, Mail Slot 4945 Pine Bluff, AR 71601
Office (870) 575-8774 Fax (870) 575-8776 Email: cs@uapb.edu
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