AWARD NUMBER: W81XWH-21-1-0541

TITLE: Chronic Studies of Spinal Cord Stimulation for Restoration of Bladder Function

PRINCIPAL INVESTIGATOR: Warren Grill

CONTRACTING ORGANIZATION: Duke University

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Fort Detrick, Maryland 21702-5012

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Distribution Unlimited

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4. TITLE AND SUBTITLE

Chronic Studies of Spinal Cord Stimulation for Restoration of Bladder Function

5a. CONTRACT NUMBER
W81XWH-21-1-0541

5b. GRANT NUMBER
SC200190

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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Em Abbott, PhD

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5d. PROJECT NUMBER
0011611760

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Duke University
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9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

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11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

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13. SUPPLEMENTARY NOTES

14. ABSTRACT
Our objective is to conduct chronic in vivo studies of a novel approach to treat urinary incontinence and poor bladder emptying following spinal cord injury (SCI). We will measure changes in bladder storage and voiding function produced by epidural kilohertz-frequency spinal cord stimulation (KHF SCS) in preclinical experiments in rats. This novel mode of SCS is used successfully to treat chronic pain but has not been developed for treatment of bladder dysfunction. Our acute studies revealed that KFH SCS at four weeks after complete spinal transection reduced the very large bladder capacities that result from SCI, increased voiding efficiency, and reduce non-voiding contractions. While promising, these experiments were limited to terminal acute studies under anesthesia. To advance this novel therapeutic approach, we are conducting chronic studies of the effects of KHF SCS on bladder function in awake, behaving animals following either transection or contusion SCI. These studies take advantage of our established capacity to deliver on-demand electrical stimulation and continuously monitor bladder pressure, external urethral sphincter (EUS) activity, and voiding behavior in awake, behaving animals.

15. SUBJECT TERMS
Spinal cord injury, bladder, electrical stimulation, therapy

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			USAMRDC
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1. **INTRODUCTION:** *Narrative that briefly (one paragraph) describes the subject, purpose and scope of the research.*

Spinal cord injury (SCI) causes bladder dysfunction, specifically urinary incontinence and the inability to empty the bladder voluntarily. Bladder dysfunction after SCI shares pathophysiologies with neuropathic pain. There are commercially available and successful treatments for chronic pain using high frequency electrical stimulation in people, but these therapies have not been developed to treat bladder dysfunction. In this study, we evaluate changes in bladder storage and voiding function produced by epidural kilohertz-frequency spinal cord stimulation (KHF SCS) in preclinical experiments in rats. Our objective is to conduct chronic in vivo studies to advance a novel therapeutic approach that restores bladder function for individuals living with SCI.

2. **KEYWORDS:** *Provide a brief list of keywords (limit to 20 words).*

Spinal cord injury, bladder, electrical stimulation, therapy

3. ACCOMPLISHMENTS: *The PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency grants official whenever there are significant changes in the project or its direction.*

What were the major goals of the project?

List the major goals of the project as stated in the approved SOW. If the application listed milestones/target dates for important activities or phases of the project, identify these dates and show actual completion dates or the percentage of completion.

Major Goals	Target Date	Completion
Major Task 0: Submit regulatory documents and obtain necessary approvals for study initiation	12/1/2021	100%, 5/10/2021
Milestone(s) Achieved: Duke University IACUC protocol approved, DoD ACURO approval obtained.		
Specific Aim 1: Chronic Evaluation of KHF Spinal Cord Stimulation Following Transection SCI		
Major Task 1.1: Conduct survival surgeries (n=10) to implant telemeter and SCS electrodes.	2/1/2022	10%
Major Task 1.2: Baseline monitoring (2 weeks) of bladder function in metabolic cages (n=10 from MT1.1).	3/1/2022	10%
Major Task 1.3: Conduct survival surgical procedures (n=10 from MT1.22) to administer transection SCI surgeries & recovery.	5/1/2022	0%
Major Task 1.4: Ongoing weekly assessment of effects of KHF SCS on voiding in metabolic cages (n=10 from MT1.3).	9/1/2022	0%
Major Task 1.5: Conduct data processing and statistical analysis to quantify effects of KHF SCS on voiding behavior.	11/1/2022	0%
Milestone(s) Achieved: During the reporting activity, we have addressed critical roadblocks which include personnel turnover, supply chain delays and technological issues. Since January 2022, we have made significant strides in hiring and training new personnel. Additionally, we have collaborated with our instrumentation provider, TSE-Systems, to improve firmware and hardware design of the telemeter implants. With these substantial efforts in training and refinement we are now poised to collect chronic in vivo data of bladder function after spinal cord injury.		

What was accomplished under these goals?

For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results or key outcomes, including major findings, developments, or conclusions (both positive and negative); and/or 4) other achievements. Include a discussion of stated goals not met. Description shall include pertinent data and graphs in sufficient detail to explain any significant results achieved. A succinct description of the methodology used shall be provided. As the project progresses to completion, the emphasis in reporting in this section should shift from reporting activities to reporting accomplishments.

In this study, we evaluate changes in bladder storage and voiding function produced by epidural kilohertz-frequency spinal cord stimulation (KHF SCS) in preclinical experiments in rats. To deliver KHF SCS, we surgically implant a paddle electrode into the epidural space of the spinal cord. To measure bladder function, we surgically implant a wireless radio telemeter device in the abdomen of rats. The telemeter implant has electromyography (EMG) leads that measure muscle activity of the external urethral sphincter (EUS) and a pressure gauge that measures detrusor muscle activity.

Subtask 0.1: Obtain Duke University IACUC approval for rat experiments

For the use of rats, we secured DUKE IACUC approval for protocol number A079-21-04 on April 20, 2021 entitled “Chronic Studies of Spinal Cord Stimulation for Restoration of Bladder Function.” IACUC approval expires March 31, 2024.

Subtask 0.2: Submit documents for rat experiments to DoD ACURO

We submitted documents to the Animal Care and Use Review Office (ACURO) and received approval on May 10, 2021 for protocol number SC200190.e001.

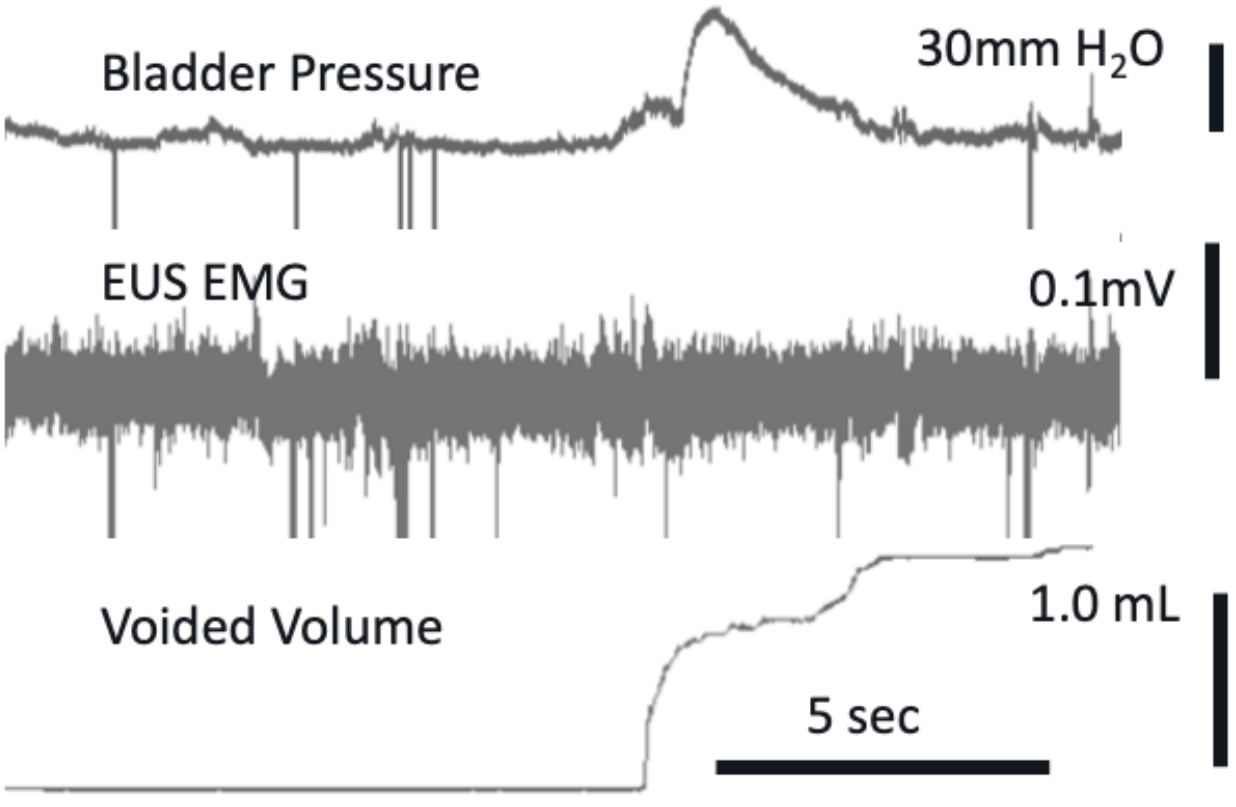
Subtask 0.3: Review and make modifications as needed to regulatory document, and obtain ACURO approval

We have not modified procedures described in protocol A079-21-04. In the event of any significant changes, we will follow Duke and DoD policies for review and approval.

Major Task 1.1: Conduct survival surgeries (n=10) to implant telemeter and SCS electrodes. We are making progress to meet this goal. New project lead, Em Abbott (see Change 1.1a), completed surgical training to implant telemeters and SCS electrodes. Training in the Grill Lab consisted of observing and conducting many surgeries on rat bladders and spinal cords (n>30). On other projects, Dr. Abbott has conducted acute bladder and laminectomy surgeries (A110-22-06 Project; n=15) and survival spinal cord transection surgeries (A144-21-07 Project, n=1). We were delayed in starting training on CDMRP specific skills due to unforeseen delays in acquiring the new version of the telemeter implants (see Problem 1.1). On this CDMRP project, Dr. Abbott has conducted implant surgeries on cadavers (n=3), acute implant surgeries (n=2), survival implant surgeries (n=2) and acute contusion surgeries (n=2).

Major Task 1.2: Baseline monitoring (2 weeks) of bladder function in metabolic cages (n=10) from MT1.1). The metabolic cages are now located in a different location (see Change 1.2a). We have collected data of baseline bladder function (n=2) in metabolic cages with new versions of the telemeter implant (see Change 1.2b). These data have highlighted issues with telemeter implant software and hardware (see Problem 1.2a-c). We continue to collaborate with TSE-Systems to refine the software and hardware of the new telemeter implant versions and we expect 4 issue free telemeters in mid-October.

Figure 1: Exemplary time-series data of voiding event during 24hr recording Key experimental parameters collected by project lead of baseline bladder function were recorded in our metabolic cage of **A)** pressure sensor data (mmHg) and B) unfiltered EMG EUS (mV) and C) filtered EMG EUS (mV) and D) total weight of urine voided (mL)



What opportunities for training and professional development has the project provided?
If the project was not intended to provide training and professional development opportunities or there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. "Training" activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency. Training activities may include, for example, courses or one-on-one work with a mentor. "Professional development" activities result in increased knowledge or skill in one's area of expertise and may include workshops, conferences, seminars, study groups, and individual study. Include participation in conferences, workshops, and seminars not listed under major activities.

Nothing to Report

How were the results disseminated to communities of interest?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how the results were disseminated to communities of interest. Include any outreach activities that were undertaken to reach members of communities who are not usually aware of these project activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.

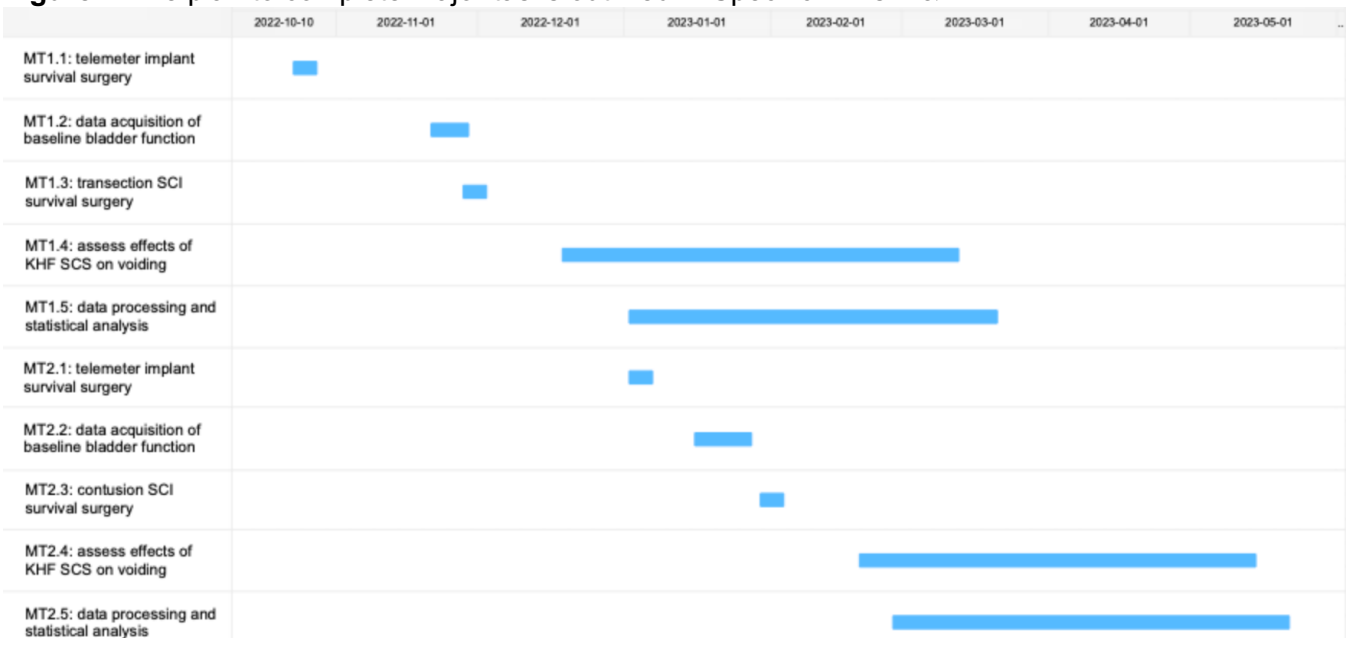
Nothing to Report.

We have yet to initiate publications or conference abstracts to disseminate findings from this project. Dr. Timothy Faw, chair for Gordon Research Conference "Spinal cord injury and repair: from mechanisms to translation" has invited us to submit an abstract for the seminar, July 8-9, 2023. We plan to submit an abstract by April 2, 2023.

What do you plan to do during the next reporting period to accomplish the goals?
If this is the final report, state "Nothing to Report."

Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.

Figure 2: We plan to complete major tasks outlined in Specific Aims 1 & 2.



4. **IMPACT:** D*escribe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to:*

What was the impact on the development of the principal discipline(s) of the project?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how findings, results, techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research in the principal disciplinary field(s) of the project. Summarize using language that an intelligent lay audience can understand (Scientific American style).

Nothing to Report

What was the impact on other disciplines?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.

Nothing to Report

What was the impact on technology transfer?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe ways in which the project made an impact, or is likely to make an impact, on commercial technology or public use, including:
- *transfer of results to entities in government or industry;*
- *instances where the research has led to the initiation of a start-up company; or*
- *adoption of new practices.*

Nothing to Report

What was the impact on society beyond science and technology?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world on areas such as:
- *improving public knowledge, attitudes, skills, and abilities;*
- *changing behavior, practices, decision making, policies (including regulatory policies), or social actions; or*
- *improving social, economic, civic, or environmental conditions.*

Nothing to Report

5. CHANGES/PROBLEMS: *The PD/PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency grants official whenever there are significant changes in the project or its direction. If not previously reported in writing, provide the following additional information or state, "Nothing to Report," if applicable:*

Changes in approach and reasons for change

Describe any changes in approach during the reporting period and reasons for these changes. Remember that significant changes in objectives and scope require prior approval of the agency.

Nothing to Report, no significant changes in the project or the scope of the research direction.

Actual or anticipated problems or delays and actions or plans to resolve them

Describe problems or delays encountered during the reporting period and actions or plans to resolve them.

Change 1.1a: personnel turnover in project lead investigators.
Chris Langdale is a Grill Lab alumn (Research Scientist, 2012-2021) who has deep expertise in surgical and technical methods used to measure the effects of electrical stimulation therapy on bladder function. In September 2021, Chris changed career paths and is now the Eastern Regional Sales Manager for TSE-Systems. TSE-Systems produce the wireless Stellar Telemetry devices and data acquisition software we use in this CDMRP project.

In January 2022, we hired a new research scientist to lead the CDMRP project, Dr. Em Abbott. We continue to have a collaborative and professional relationship with Chris. We contact Chris at TSE-Systems for customer and technical support. We also pay Chris as a private contractor to provide in person and remote training to Dr. Abbott to ensure the continued success and high standard of quality of this project. Our initial timeline has delayed due to the time it takes to onboard and train new personnel. Dr. Abbott has completed all training required to conduct survival implant surgeries.

Problem 1.1: research timeline postponed by manufacturing delays
We sent a procurement order (PO 4551095670) to TSE-Systems on 11/19/2021 which was confirmed 11/24/2021. After manufacturing delays, we received the telemeter implants on 3/31/2022 and the extension antenna cables for our receiver on 5/9/2022.

Corrective Action 1.1: We focused on training skills that did not involve the telemeter implant such as installing headcaps, placing electrodes and familiarizing ourselves with Stellar Commander and Notocord software. In early March 2022, we began surgical training with old versions of the telemeter implants. Once we received the new telemeter implants, we began survival surgical training in pilot rats (n=2).

Change 1.2a: metabolic cage site relocation from Vivarium room 1039 to room 1092
Duke Facility Operations requested that we move our metabolic cage data acquisition set up out of room 1039 to address growing animal housing needs at our research site. In August 2022, we coordinated with Duke Operations Managers and Staff to move large electrical equipment racks and metabolic cages from room 1039 to room 1092. Overall, the room change is an improvement in data acquisition conditions. Room 1092 is in a more secluded hallway which is quieter and has less foot traffic. Room 1092 also allows easier management of hygienic conditions because the room has a sink and is closer to cage cleaning facilities.

Change 1.2b: new Stellar Implantable Transmitters (Type PBTA-L1-C, Cat.-No: E-430001-IMP-88)
We require custom telemeter implants that have fine recording resolution and can last the entirety of the four month timeframe to adequately address the scope of this study. Specifically we requested 1000Hz recording frequency of the EUS EMG to detect skeletal muscle activity and extensive battery life. TSE-Systems manufactured custom telemeter implants that meet these needs. The new model has a smaller body (17.3g) that is less intrusive when secured in the abdominal cavity and has firmware that regulates battery power by allowing instrumentation to lie dormant when not in use. Firmware also extends battery power by recording data at various frequencies ex: pressure gauge 100Hz; EUS EMG 1000Hz.

Figure 3: New Stellar Telemeter Implant with scale bar. EMG EUS biopotential leads (blue and pink shielding) are 20cm long and have a medical silicone mesh (clear rectangle) to secure to the deep surface of the pubic symphysis. Pressure gauge is at the end of the third wire with the clear shielding. Magnet on the telemeter body ensures all instrumentation remains in shutdown mode until magnet is removed prior to implantation.

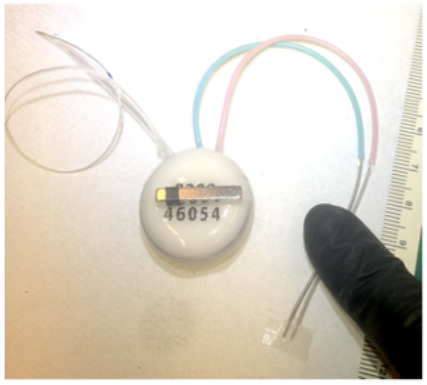


Figure 3: New Stellar Telemeter Implant with scale bar. EMG EUS biopotential leads (blue and pink shielding) are 20cm long and have a medical silicone mesh (clear rectangle) to secure to the deep surface of the pubic symphysis. Pressure gauge is at the end of the third wire with the clear shielding. Magnet on the telemeter body ensures all instrumentation remains in shutdown mode until magnet is removed prior to implantation.

Problem 1.2a- large amplitude noise issues in the EMG biopotential channel
We observed significant noise (>5mV amplitude) in the EMG readings that would inhibit our ability to characterize EUS activity.

Corrective Action 1.2a: successful firmware version developed to eliminate noise from pressure sensor
We requested that TSE-Systems identify the source of the noise and reduce it to an acceptable amplitude. After a survival surgery in pilot_rat3 on 6/7/2022, TSE advised us not to continue with surgical implantation until firmware updates were installed in telemeters. Tom Delahanty, Telemetry Division Technical Director, identified that the source of the noise was due to the intermittent on/off mode of the pressure sensor. We were offered an alternative solution to leave the pressure sensor on 100% of the time. This solution would limit our battery life and consequently reduce the scope of this research project. We communicated our strong preference to receive a firmware update that maintained extensive battery life. As of 7/11/2022 no firmware updates eliminated the noise issue, and we restated our need for accurate telemetry. By 7/15/2022 Tom developed a firmware version (ULC AU-v4_95_06) that did not increase the amount of power used by the battery and eliminated the noise issue. Dr. Abbott met with Tom 7/15/2022 over Zoom and uploaded the new firmware to the telemeters and requested a replacement telemeter to compensate for the noise issues in a previous pilot rat implant. Noise is now within acceptable amplitude of +/- 0.3mV. We received a replacement telemeter 7/26/2022.

Problem 1.2b- issues with data acquisition where Access Point was not recognized
Confirmed that computer recognizes the COM ports for the receiver via the USB connector. tried power cycling computer and receiver. Also attempted to reset access point. Confirmed that Access Point was recognized on another computer in the lab and that all FTDI drivers were the same between the two computers.

Corrective action 1.2b- receiver initialization process establishes USB connection between receiver and COM port connection
We contacted COO and Global Stellar Product Manager, Bob Brockway, 8/11/2022. Bob shared stepwise instructions, not in the manual, on how to initialize the telemeter receiver.

Problem 1.2c- silicone mesh on the EMG leads tore easily during survival surgical implantation
While practicing survival surgery on pilot rats, both Dr. Steadman and Dr. Abbott experienced issues with the silicone tearing along the outside of the fiber mesh under reasonable tension from 6-0 non absorbable suture. Dr. Abbott requested reinforced silicone mesh in replacement telemeter. We received replacement telemeter on 7/26/2022 with a stainless-steel mesh embedded in medical grade silicone. Unfortunately, the spacing on the metal mesh was too small to pass a needle through. Dr. Abbott met with TSE-Systems team on 9/15/2022 and collaborated on a new design.

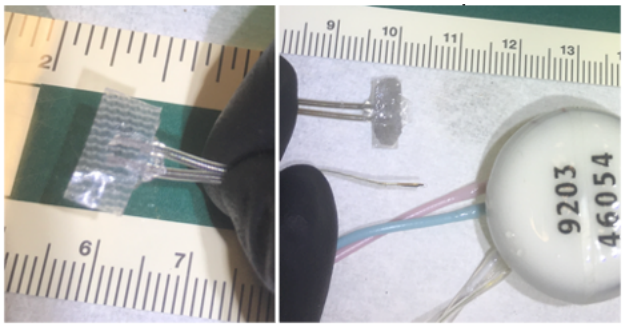
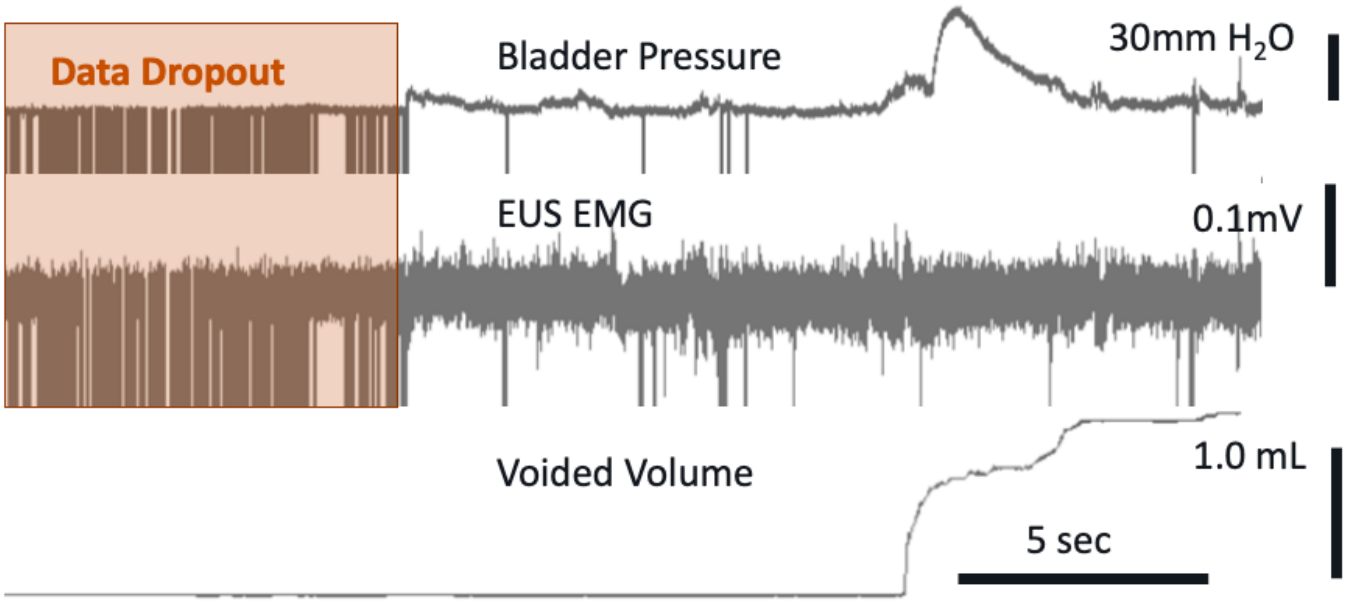


Figure 4: EMG electrode leads are connected to a small rectangle of material for placement on the deep side of the pubic symphysis A) Fiber mesh embedded in silicone tears easily B) Stainless steel mesh does not accommodate small surgical needles

Problem 1.2- data dropout issues in all telemeter channels
At the 2022 Annual Society of Neuroscience Triangle Meeting on 9/9/2022, we requested that TSE-Systems identify the source of the data dropout. We met with a team of TSE-System staff on 9/15/2022 and we were told the receiver power needs to be tuned to the telemeter power with a firmware update. We were advised that this firmware update needs to be installed while there is an telemeter implanted in vivo so that the transmitted data reflect experimental conditions.

Figure 5: data dropout issues in pressure sensor and EMG channels Exemplary time-series of in vivo data that demonstrates frequent data dropouts in pressure sensor data (top panel) and unfiltered EMG EUS (middle panel) and filtered EMG EUS (bottom panel). The drop-out occurred in the metabolic cage room but not in the chronic surgery room.



Corrective action 1.2d- we will implant two of our used telemeters (#9203 and #9209) into pilot rats and tune the receiver power to the telemeter power via a firmware update
We plan to perform this corrective action in early October. We will also check that the antennas in the metabolic cage room are not causing the dropout.

Change 1.3: personnel turnover in animal care providers
Casey Steadman (postdoctoral fellow, 2020-2022) trained Dr. Abbott in protocols and procedures in the Grill Lab. Dr. Steadman has deep expertise in spinal cord injury in rats and spent a significant amount of time training Dr. Abbott in contusion SCI procedures so that we are best prepared to conduct our second Aim. Dr. Steadman had limited availability over the summer (vacation June 23-July 5; writing sabbatical July 27-Aug. 10). In August, Dr. Steadman accepted a job offer at Rho and left the Grill Lab.

It is difficult to conduct SCI research with only one staff member because after survival SCI bladders must be expressed via the Crede method 3 times daily with no longer than 12hrs between expressions. This supportive animal care continues until reflexive voiding returns, allowing for close observation of urine and prevention of bladder ruptures. Unfortunately, animals surviving transection SCI do not recover reflexive voiding for several weeks. Thus, the animal care demands of SCI research are often too great for one staff member. We identified appropriate personnel in our laboratory (Khoa Do and Dr. Katherine Lambert) who could assist with bladder expressions. We also identified a faculty member, Dr. Tim Faw, who has expertise in rodent SCI models who agreed to consult if needed. Duke IACUC approved adding these personnel to our protocol on 8/4/2022. In mid-August, we also advertised, interviewed and recruited two undergraduate research assistants, Priscilla La and Jonathan Wu, who could provide 5-10hrs/week for animal care.

Changes that had a significant impact on expenditures
Describe changes during the reporting period that may have had a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.

Nothing to Report

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents
Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, biohazards, and/or select agents during the reporting period. If required, were these changes approved by the applicable institution committee (or equivalent) and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.

Nothing to Report

Significant changes in use or care of human subjects

Nothing to Report

Significant changes in use or care of vertebrate animals

Nothing to Report

Significant changes in use of biohazards and/or select agents

Nothing to Report

6. **PRODUCTS:** *List any products resulting from the project during the reporting period. If there is nothing to report under a particular item, state "Nothing to Report."*

- **Publications, conference papers, and presentations**
  Report only the major publication(s) resulting from the work under this award.

  Journal publications. *List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

Nothing to Report

  Books or other non-periodical, one-time publications. *Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like. Identify for each one-time publication: author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (e.g., book, thesis or dissertation); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

Nothing to Report

  Other publications, conference papers and presentations. *Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication as noted above. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (*) if presentation produced a manuscript.*

Nothing to Report

- **Website(s) or other Internet site(s)**
  List the URL for any Internet site(s) that disseminates the results of the research activities. A short description of each site should be provided. It is not necessary to include the publications already specified above in this section.

Nothing to Report

- **Technologies or techniques**
  Identify technologies or techniques that resulted from the research activities. Describe the technologies or techniques were shared.

Nothing to Report

- **Inventions, patent applications, and/or licenses**
  Identify inventions, patent applications with date, and/or licenses that have resulted from the research. Submission of this information as part of an interim research performance progress report is not a substitute for any other invention reporting required under the terms and conditions of an award.

Nothing to Report

- **Other Products**
  Identify any other reportable outcomes that were developed under this project. Reportable outcomes are defined as a research result that is or relates to a product, scientific advance, or research tool that makes a meaningful contribution toward the understanding, prevention, diagnosis, prognosis, treatment and /or rehabilitation of a disease, injury or condition, or to improve the quality of life. Examples include:
  - *data or databases;*
  - *physical collections;*
  - *audio or video products;*
  - *software;*
  - *models;*
  - *educational aids or curricula;*
  - *instruments or equipment;*
  - *research material (e.g., Germplasm; cell lines, DNA probes, animal models);*
  - *clinical interventions;*
  - *new business creation; and*
  - *other.*

Nothing to Report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Provide the following information for: (1) PDs/PIs; and (2) each person who has worked at least one person month per year on the project during the reporting period, regardless of the source of compensation (a person month equals approximately 160 hours of effort). If information is unchanged from a previous submission, provide the name only and indicate "no change".

Example:

Name: *Mary Smith*
Project Role: *Graduate Student*
Researcher Identifier (e.g. ORCID ID): *1234567*
Nearest person month worked: *5*

Contribution to Project: *Ms. Smith has performed work in the area of combined error-control and constrained coding.*
Funding Support: *The Ford Foundation (Complete only if the funding support is provided from other than this award.)*

Name:	*Warren M. Grill*
Project Role:	*PI*
Nearest person month worked:	*0.45 Academic and 0.58 Summer months—1.03 total months*
Contribution to project:	Conception and design of the work
Funding Support:	*n/a*

Name:	*Emily Abbott*
Project Role:	*Research Scientist*
Nearest person month worked:	*7.2 months*
Contribution to project:	Lead investigator conducting experiments, performing survival surgeries, managing undergraduate animal care assistants
Funding Support:	*n/a*

Name:	*Casey Steadman*
Project Role:	*Postdoctoral Scholar*
Nearest person month worked:	*0 months*
Contribution to project:	Training spinal cord injury procedures and protocols to Dr. Abbott. Assistance with post-operative animal care
Funding Support:	*NIH K12 trianing fellowship*

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

If the active support has changed for the PD/PI(s) or senior/key personnel, then describe what the change has been. Changes may occur, for example, if a previously active grant has closed and/or if a previously pending grant is now active. Annotate this information so it is clear what has changed from the previous submission. Submission of other support information is not necessary for pending changes or for changes in the level of effort for active support reported previously. The awarding agency may require prior written approval if a change in active other support significantly impacts the effort on the project that is the subject of the project report.

Please see Attached DoD Other Support for details of Warren Grill's Other Support.

Duke MedX—ended, University of North Carolina-CH (Prime sponsor, NIH 1R01NS091236)—ended, Northwestern University (prime sponsor, NIH 5R01NS095251)—ended, R03HD094614—ended, R44NS115169—ended, 1R21EY031271—ended, Alfred E. Mann Foundation—new, Boston Scientific, Innovations—new, Boston Scientific, Deep Brain—new, W81XWH211054—new, R01-MH128422-01—new, University of Wisconsin-Madison—new, Terasaki Institute—new (prior Duke, NIH Shen award), University of Florida—new, Coulter Duke Translation Grant Program—new, Duke OTC Translation Fund—new, NIH REVA–new.

What other organizations were involved as partners?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe partner organizations – academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or other organizations (foreign or domestic) – that were involved with the project. Partner organizations may have provided financial or in-kind support, supplied facilities or equipment, collaborated in the research, exchanged personnel, or otherwise contributed.

Provide the following information for each partnership:
Organization Name:
Location of Organization: (if foreign location list country)
Partner's contribution to the project (identify one or more)

- *Financial support;*
- *In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff);*
- *Facilities (e.g., project staff use the partner's facilities for project activities);*
- *Collaboration (e.g., partner's staff work with project staff on the project);*
- *Personnel exchanges (e.g., project staff and/or partner's staff use each other's facilities, work at each other's site); and*
- *Other.*

Nothing to Report

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS: *For collaborative awards, independent reports are required from BOTH the Initiating Principal Investigator (PI) and the Collaborating/Partnering PI. A duplicative report is acceptable; however, tasks shall be clearly marked with the responsible PI and research site. A report shall be submitted to* ***https://ebrap.org/eBRAP/public/index.htm*** *for each unique award.*

QUAD CHARTS: *If applicable, the Quad Chart (available on https://www.usamraa.army.mil/Pages/Resources.aspx) should be updated and submitted with attachments.*

See Quad Chart attached

9. APPENDICES: *Attach all appendices that contain information that supplements, clarifies or supports the text. Examples include original copies of journal articles, reprints of manuscripts and abstracts, a curriculum vitae, patent applications, study questionnaires, and surveys, etc.*

Chronic Studies of Spinal Cord Stimulation for Restoration of Bladder Function
Investigator-Initiated Research Award Proposal
Contract Number: W81XWH2110541

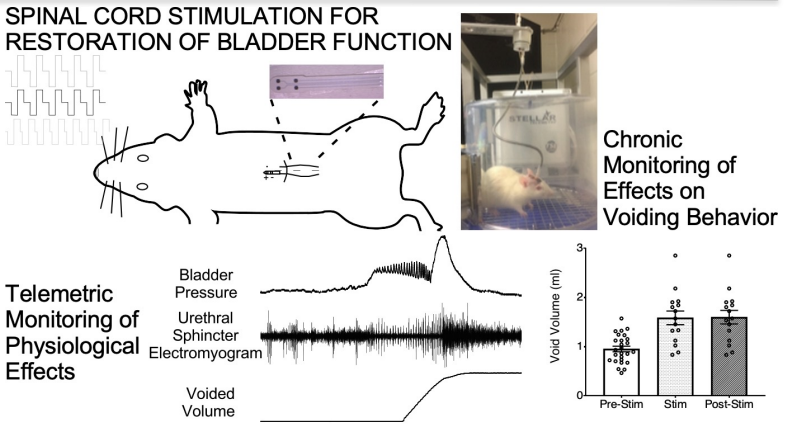
PI: Warren M Grill, PhD **Org:** Duke University **Award Amount:** $803,991

Study Aim(s)

- Conduct *in vivo* studies of a novel approach to treat urinary incontinence and poor bladder emptying following spinal cord injury (SCI).
- Quantify the effects of KHF SCS on voiding behavior in awake behaving rats following either transection or contusion spinal cord injury.
- Map the locations of spinal cord neurons with activity modulated by application of KHF SCS
- Establish the feasibility and appropriate stimulation parameters for this innovative approach to restore bladder function following SCI

Approach

Measure in preclinical experiments in rats the changes in bladder function produced by epidural kilohertz-frequency spinal cord stimulation (KHF SCS)



Accomplishment: IACUC Approval secured
Accomplishment: Successful monitoring of bladder pressure and EUS activity with next generation telemeter system.

Timeline and Cost

Activities	21	22	23	24
IACUC Approval for all studies				
Impact on continence and voiding behavior following transection SCI				
Impact on continence and voiding behavior following contusion SCI				
Mapping of neurons activated by epidural SCS				
Estimated Budget ($direct)	**~$65k**	**~$85k**	**~$185k**	**~$165k**

Updated: (9/23/2022)

Goals/Milestones

CY21 Goal – Initiation of Chronic Studies following Complete SCI
☑ IACUC Approval
☑ Initiate awake functional studies of KHF SCS on voiding behavior following complete (transection) SCI
CY22 Goal – Complete Chronic Studies following Complete SCI
☐ Complete awake functional studies of KHF SCS on voiding behavior following complete (transection) SCI.
☐ Immunohistochemical mapping of spinal neurons with activity modulated by KHF SCS
CY23 Goal – Transition to Chronic Studies following Incomplete SCI
☐ Initiate awake functional studies of KHF SCS on voiding behavior following incomplete (contusion) SCI.
CY24 Goal – Plan for Translation to Human
☐ Complete awake functional studies and mapping studies
☐ Plan for translational studies in humans with SCI

Budget Expenditure to Date: $113,606 direct, $182,909 total

Other Support 10/1/2022

GRILL, WARREN M.

Changes: Duke MedX—ended, University of North Carolina-CH (Prime sponsor, NIH 1R01NS091236)—ended, Northwestern University (prime sponsor, NIH 5R01NS095251)—ended, R03HD094614—ended, R44NS115169—ended, 1R21EY031271—ended, Alfred E. Mann Foundation—new, Boston Scientific, Innovations—new, Boston Scientific, Deep Brain—new, W81XWH211054—new, R01-MH128422-01—new, University of Wisconsin-Madison—new, Terasaki Institute—new (prior Duke, NIH Shen award), University of Florida—new, Coulter Duke Translation Grant Program—new, Duke OTC Translation Fund—new, NIH REVA–new.

CURRENT SUPPORT

Title: Temporal Patterns of Deep Brain Stimulation

Time Commitments: 2% academic effort (or 1.5% calendar effort)

Supporting Agency: NIH-NINDS, R37NS040894-17

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Denise Chatman, Grants Management Specialist
National Institute of Neurological Disorders and Stroke
6001 Executive Boulevard, Suite 3290, MSC 9537
Bethesda, MD 20892
chatmand@ninds.nih.gov

Performance Period: 9/30/19-8/31/23 (in NCE)

Level of Funding: total cost

Goals/Aims: The objective of this project is to determine the effects of the temporal patterns of stimulation on the neural and behavioral responses to deep brain stimulation.

Identify where projects overlap or parallel: None

Title: Modeling Activation and Block of Autonomic Nerves for Analysis and Design

Time Commitments: 2% academic effort (or 1.5% calendar effort)

Supporting Agency: NIH, 1OT2OD025430

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Irene Haas,
Office of the Director, NIH
Irene.haas@nih.gov

Performance Period: 9/2/17-8/31/23 (in NCE)

Level of Funding: total cost

Goals/Aims: The objective of this project is to development a pipline for analysis and design of autonomic nerve stimulation and block.

Identify where projects overlap or parallel: None

Title: Time domain approaches to increase the efficacy of spinal cord stimulation

Time Commitments: 1% academic effort (or 0.5% calendar effort)

Supporting Agency: Boston Scientific

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Marianna Sokolov
PO Box 9197
Canton, MA 02021

Performance Period: 6/1/16-12/31/2022 (in NCE)

Level of Funding: total cost

Goals/Aims: The objective of this project is to develop patterns of intracortical microstimulation to provide somatosensory feedback for prosthetics.

Identify where projects overlap or parallel: None

Title: Analysis and Optimization of Subperception Spinal Cord Stimulation

Time Commitments: 1% academic effort (or 0.5% calendar effort)

Supporting Agency: Boston Scientific

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Marianna Sokolov
PO Box 9197
Canton, MA 02021

Performance Period: 6/1/16-12/31/2023 (in NCE)

Level of Funding: total cost

Goals/Aims: The objective of this work is to develop innovative approaches to improve the outcomes of spinal cord stimulation (SCS) for treatment of chronic pain.

Identify where projects overlap or parallel: None

Title: Scalar Closed-Loop STN/GPI DBS Based on Evoked and Spontaneous Potentials

Time Commitments: 2.2% academic effort (or 1.6% calendar effort)

Supporting Agency: DHHS, 1UH3NS103468 (PI-Turner)

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Denise Chatman
National Institutes of Neurological Disorders and Stroke
6001 Executive Boulevard, Suite 3290, MSC 9537
Rockville, MD 20852
Bethesda, MD 20892-9537
Email: chatmand@ninds.nih.gov

Performance Period: 9/15/17-1/31/23 (in NCE)

Level of Funding: total costs

Goals/Aims: The objective of this project is to develop and evaluate the efficacy of a closed-loop system to control the symptoms of Parkinson's disease by subthalamic nucleus deep brain stimulation.

Identify where projects overlap or parallel: None

Title: Spinal Cord Stimulation for Restoration of Bladder Function

Time Commitments: 3.5% academic effort and 0.6% summer effort (or 2.8% calendar effort)

Supporting Agency: The Craig H. Neilsen Foundation

Name and Address of the Funding Agency's Procuring Contracting/Grans Officer:

Ehrica Hernandez
Grants Management Associate
ehrica@chnfoundation.org

Performance Period: 7/31/19-4/30/23 (in NCE)
Level of Funding: total cost
Goals/Aims: Our objective is to conduct in vivo studies of a novel approach to treat urinary incontinence and poor bladder emptying following spinal cord injury (SCI).
Identify where projects overlap or parallel: None. This project does nor conduct any chronic studies, as proposed in SC00190, but rather exclusively acute terminal experiments.

Aim 1 is to determine the parameters of KHF SCS that suppress NDO (reduce non-voiding contractions) and suppress DSD (increase voiding efficiency) in healthy anesthetized rats before and after installation in the bladder of acetic acid, which generates bladder hypersensitivity (NDO) and inefficient bladder emptying (DSD), similar to what is observed after SCI.

Aim 2 is to identify the frequency and amplitude of SCS that are most effective at reducing NDO and DSD in acute experiments on anesthetized rats four weeks after either complete spinal cord transection or moderate contusion injury.

Aim 3 is to develop an algorithm to identify optimal parameters of SCS to restore bladder function.

Title: Temporal Patterns of Spinal Cord Stimulation
Time Commitments: 2% academic effort (or 1.5% calendar effort)
Supporting Agency: NIH U18EB029257
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Grants Management Specialist: Florence Turska
Email: ft7p@nih.gov

Performance Period: 9/30/19-9/29/23 (in NCE)
Level of Funding: total cost
Goals/Aims: The objective is to design and test optimized temporal patterns of stimulation to improve the efficacy of SCS to treat chronic neuropathic pain.
Identify where projects overlap or parallel: None

Title: Spinal Cord Stimulation for Restoration of Bladder Function
Time Commitments: 2.8% academic and 2.3% summer effort (or 2.7% calendar effort)
Supporting Agency: Paralyzed Veterans of America
Name and address of Funding Agency's Procuring Contracting/Grants Officer:
Rita Obi, Associate Director, Research & Education
ritao@pva.org

Performance Period: 3/1/20-2/28/23 (in NCE)
Level of Funding: total cost
Goals/Aims: Our objective is to conduct in vivo studies of a novel approach to treat urinary incontinence and poor bladder emptying following spinal cord injury (SCI).
Identify where projects overlap or parallel: None. This project does nor conduct any chronic studies, as proposed in SC00190, but rather exclusively acute terminal experiments.

Aim 1 is to quantify the effects of SCS location on voiding behavior in acute terminal experiments, including NDO and DSD, in rats following contusion SCI. Location specifies the rostrocaudal and mediolateral location of the epidural stimulation.

Aim 2 is to determine the neural pathways that mediate the effects of SCS on voiding behavior, including NDO and DSD. We will quantify input-output properties of neural pathway activation by SCS in acute terminal experiments by measuring the compound nerve action potentials evoked in the sciatic, pudendal, and pelvic nerves as a function of the SCS amplitude and location.

Title: MPS-TMS: Modular Pulse Synthesizer for Transcranial Magnetic Stimulation with Fully Adjustable Pulse Shape and Sequence

Time Commitments: 4% academic effort and 4% summer effort (or 4% calendar effort)

Supporting Agency: NIH, 1RF1MH124943 (PI-Goetz)

Name and Address of Funding Agency's Procuring Contracting/Grants Officer:

Christine Clarkson, Grants Management Specialist
NIMH
Christine.wise@nih.gov

Performance Period: 9/14/20-9/13/24

Level of Funding: total cost

Goals/Aims: This project will develop and test in human subjects a novel transcranial magnetic stimulation (TMS) device that is able to generate practically any pulse shape and pulse sequence for more selective stimulation and stronger neuromodulation.

Identify where projects overlap or parallel: None

Title: Biology and Biophysics of Cortical Response to Transcranial Magnetic Stimulation

Time Commitments: 8% academic effort and 6.3% summer effort (or 7.5% calendar effort)

Supporting Agency: NIH, 1R01NS117405 (PIs-Sommer, Grill, Peterchev)

Name and Address of Funding Agency's Procuring Contracting/Grants Officer:

Elizabeth Conklin, Grants Management Specialist
NINDS
conklinee@ninds.nih.gov

Performance Period: 9/30/20-6/30/25

Level of Funding:

Goals/Aims: Our overall goal is to fill in this knowledge gap by studying the neural circuit mechanisms of TMS in the non-human primate brain.

Identify where projects overlap or parallel: None

Title: Computational Modeling Of Vagus Nerve Stimulation

Time Commitments: 3.3% summer effort (or 0.8% calendar effort)

Supporting Agency: Alfred E. Mann Foundation

Name and Address of Funding Agency's Procuring Contracting/Grants Officer:

Bob Greenberg, The Alfred Mann Foundation for Scientific Research, 25134 Rye Canyon Loop, Valencia, CA 91355

Performance Period: 2/1/2022-1/31/2023

Level of Funding:
Goals/Aims: The goal of this research is to implement and simulate computational models of electrical stimulation of the vagus nerve.
Identify where projects overlap or parallel: None

Title: Sacral Nerve Stimulation to Treat Detrusor Underactivity: Parameters and Pathways
Time Commitments: 2.6% summer effort (or 0.6% calendar effort)
Supporting Agency: Medtronic
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Lance Zirpel, lance.zirpel@medtronic.com,
7000 Central Avenue NE, Minneapolis, Minnesota 55432-3576
Performance Period: 11/1/2019-4/30/2023 (in NCE)
Level of Funding:
Goals/Aims: The objective of this grant is to quantify the effects of sacral nerve stimulation parameters on voiding in the obese prone rat model of urinary retention.
Identify where projects overlap or parallel: None

Title: Innovations in Sacral Nerve Stimulation
Time Commitments: 5% summer effort (or 1.3% calendar effort)
Supporting Agency: Boston Scientific
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Michael Loughlin VP of R&D, Boston Scientific, 300 Boston Scientific Way, Marlborough, MA 01752
Performance Period: 7/1/2022-6/30/2024
Level of Funding:
Goals/Aims: We will implement high-resolution computational models of human SNS and use these models for analysis and design. We have broad and deep experience with model-based approaches including for design of electrodes for deep brain stimulation, as well as peripheral nerve stimulation.
Identify where projects overlap or parallel: None

Title: Chronic studies of spinal cord stimulation for restoration of bladder function
Time Commitments: 5% academic and 19.3% summer effort (or 8.6% calendar effort)
Supporting Agency: USAMRAA, CDMRP, W81XWH211054
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Andrea Green, Grants Specialist, andrea.c.greene.civ@mail.mil, 301-619-6961
Performance Period: 9/1/2021-8/31/2024
Level of Funding:
Goals/Aims: Our objective is to conduct chronic in vivo studies of a novel approach to treat urinary incontinence and poor bladder emptying following SCI.
Identify where projects overlap or parallel: None

Title: Deep Brain Stimulation Evoked Potentials
Time Commitments: 3.7% academic and 3.6% summer effort (or 3.7% calendar effort)
Supporting Agency: Boston Scientific
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Maulik Nanavaty, SVP & President, Boston Scientific Neuromodulation

Performance Period: 10/1/2021-9/30/2026
Level of Funding:
Goals/Aims: The objective of this research program is to characterize quantitatively the evoked potentials generated by deep brain stimulation (DBS), both locally from electrode contacts adjacent to stimulation contacts in the stimulated nucleus (DBS Local Evoked Potentials, DLEPs) and remote from subcortical stimulation in the motor cortex (CTEPs).
Identify where projects overlap or parallel: None

Title: NeuroSimNIBS: Integrated electric field and neuronal response modeling for transcranial electric and magnetic stimulation
Time Commitments: 9.8% academic and 8.3% summer effort (or 9.5% calendar effort)
Supporting Agency: NIH, R01-MH128422-01
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Monica Michelle Chavis, GMS, monica.chavis@nih.gov
Performance Period: 5/1/2022-2/28/2027
Level of Funding:
Goals/Aims: This project will develop software that estimates the direct effect of transcranial electric and magnetic stimulation on brain neurons. Aim 1: Implement high-fidelity models of cortical neurons and fibers Aim 2: Implement and validate computationally efficient estimators of neural responses to TMS and TES Aim 3: Integrate electric field and neural response simulators to create NeuroSimNIBS
Identify where projects overlap or parallel: None

Title: A Rational Engineering Design Approach to Minimizing the Off-Target Effects of Baroreceptor Activation Therapy
Time Commitments: 3.5% academic effort (or 2.6% calendar effort)
Supporting Agency: University of Wisconsin-Madison, NIH prime
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Andrew Weitz, Ph.D., Program Director, NIH/NIBIB
andrew.weitz@nih.gov
Performance Period: 7/1/2022-3/31/2026
Level of Funding:
Goals/Aims: We seek to determine the neuroanatomy responsible for the side effects of BAT and to use this information to design (and test) approaches to more efficacious BAT neural interface.
Identify where projects overlap or parallel: None

Title: Developing a comprehensive model for peripheral nerve stimulation of gastrointestinal function
Time Commitments: 1.8% academic effort (or 1.4% calendar effort)
Supporting Agency: Terasaki Institute, NIH prime
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:
Lawrence Brogan, Terasaki Institute, lbrogan@terasaki.org, 3104796101 x:104
Performance Period: 6/1/2022-5/31/2023
Level of Funding:

Goals/Aims: The objective of this project is to build and validate a computational model of the sacral nerve modulation of the enteric nervous system and gut motility. This model will be used to test a variety of stimulation parameters and patterns to identify the most effective way to treat dysmotility in the gut.

Identify where projects overlap or parallel: None

Title: Engineering the neuronal response to electrical microstimulation

Time Commitments: 4.5% academic and 10% summer effort (or 5.9% calendar effort)

Supporting Agency: University of Florida/NIH prime

Name and Address of Funding Agency's Procuring/Grants Officer:

Stephanie Gray, UFSubawards@ufl.edu, 352-392-0239

Performance Period:8/1/2022-07/31/2026

Level of Funding:

Goals/Aims: The overall objective of the proposed research is to identify the spatial, temporal, and spatiotemporal resolution of a chronically-implanted electrical microstimulation device.

Identify where projects overlap or parallel: None

Title: Patient specific programming system for vagus nerve stimulation for epilepsy

Time Commitments: 6.7% summer effort (or 1.7% calendar effort)

Supporting Agency: Coulter Duke Translation Grant Program

Name and Address of Funding Agency's Procuring/Grants Officer:

Joseph Izatt, Chair of BME

Box 90281, Durham, NC 27708

Performance Period: 9/15/2022-9/14/2023

Level of Funding:

Goals/Aims: Our goal is to conduct intraoperative experiments to collect ultrasound images and measure the electrical and physiological responses to nerve stimulation in patients undergoing VNS implantation surgery.

Identify where projects overlap or parallel: None

Title: Performance optimization of waveforms for nerve conduction block

Time Commitments: 0% effort

Supporting Agency: Duke OTC Translation Fund

Name and Address of Funding Agency's Procuring/Grants Officer: Alex Mullins, Ph.D.

Duke's Office for Translation & Commercialization, alex.mullins@duke.edu, Performance Period: 9/15/22-9/14/23

Level of Funding:

Goals/Aims: To conduct in vivo testing of novel waveforms for nerve conduction block.

Identify where projects overlap or parallel: None

Title: SPARC Reconstructing Vagal Anatomy (REVA)

Time Commitments: 5% academic and 5% summer effort (or 5% calendar effort)

Supporting Agency: NIH Prime; Subcontract from Case Western Reserve University

Name and Address of Funding Agency's Procuring/Grants Officer:

Felicia Qashu, Ph.D., felicia.qashu@nih.gov

Performance Period: 9/21/22 - 9/20/23, estimated to extend to 9/20/25

Level of Funding:
Goals/Aims: The goal is to provide essential end-use validation and demonstrated applications of analysis and design of improved VNS therapies through anatomically-realistic, biophysical, validated computational models.
Identify where projects overlap or parallel: None

IN-KIND
Title: Computational tools for improving stereo-EEG implantation and resection surgery
Time Commitments: n/a
Supporting Agency: NIH, 1F31NS124094-01A1
Name and Address of Funding Agency's Procuring/Grants Officer:
Romy Reis, Grants Management Specialist, NINDS, ReisR@nih.gov
Performance Period: 8/15/2022-8/14/2024
Level of In-Kind Funding:
Goals/Aims: Predoctoral Fellowship for Brandon Thio. Goal is to develop source reconstruction algorithms for stereo EEG
Identify where projects overlap or parallel: None

PENDING SUPPORT

Title: Optimized Electrical Block of Peripheral Nerves
Time Commitments: 20% academic and 25% summer effort (or 21.2% calendar effort)
Supporting Agency: NIH, 1R01NS126376-01A1
Name and Address of Funding Agency's Procuring/Grants Officer: unknown
Performance Period: 9/1/2022-8/31/2027
Level of Funding:
Goals/Aims: We will design and test novel nerve block waveforms and electrodes that will enable the continued advance of medical device therapies.
Identify where projects overlap or parallel: None

Title: An Integrated Biomarker Approach to Personalized, Adaptive Deep Brain Stimulation in Parkinson Disease
Time Commitments: 5% academic and 10% summer effort (or 6.2% calendar effort
Supporting Agency: NIH
Name and Address of Funding Agency's Procuring/Grants Officer: unknown
Performance Period: 12/1/2022-11/30/2026
Level of Funding:
Goals/Aims: To test this hypothesis we will perform long-term recordings of multiple, relevant biomarkers from humans with implanted, advanced implantable pulse generators [IPGs], comparing internal control modes to highly complex external control modes.
Identify where projects overlap or parallel: None

Title: Towards personalized, adaptive deep brain stimulation for gait improvement in individuals with Parkinson's disease

Time Commitments: 0% effort
Supporting Agency: Duke NC State Translational Research Grant
Name and Address of Funding Agency's Procuring/Grants Officer: unknown
Performance Period: 10/1/2022-9/30/2023
Level of Funding:
Goals/Aims: The goal of this research is to quantify the effects of closed-loop control of deep brain stimulation of walking function in persons with Parkinson's disease.
Identify where projects overlap or parallel: None

Title: CPS: Medium: Learning-Enabled Personalized Deep Brain Stimulation for Parkinson's Disease Treatment
Time Commitments: 5% academic and 5% summer effort (or 5% calendar effort)
Supporting Agency: NSF
Name and Address of Funding Agency's Procuring Contracting/Grants Officer: unknown
Period of Performance: 1/1/2023-12/31/2025
Level of Funding: total cost
Goals/Aims: The goal of this research is to implement and evaluate feedback control systems for closed-loop control of deep brain stimulation in persons with Parkinson's disease.
Identify where projects overlap or parallel: None

IN-KIND
Title: Characterizing Evoked Potentials of Deep Brain Stimulation for Parkinson's Disease
Time Commitments: n/a
Supporting Agency: NIH, 1F31NS130997-01
Name and Address of Funding Agency's Procuring/Grants Officer: unknown
Performance Period: 9/1/2022-8/31/2026
Level of In-Kind Funding:
Goals/Aims: Predoctoral Fellowsip for Jahrane Dale. Goal is to quantify evoked potentials generated by deep brain stimulation.

Title: Duke Preparing Research Scholars in Biomedical Sciences-Post-Baccalaureate Research Education Program
Time Commitments: n/a
Supporting Agency: NIH, R25GM144242
Name and Address of Funding Agency's Procuring/Grants Officer: unknown
Performance Period: 12/1/2022-11/30/2027
Level of In-Kind Funding:
Goals/Aims: Serve as training faculty for potential Predoctoral Fellow.

PREVIOUS SUPPORT

Title: Neural Electrodes with Enhanced Charge Injection and Reduced Interfacial Impedance Using Graphenated Carbon Nanotubes Coated With Atomic Layer Deposited Platinum Nanoparticles
Time Commitments: 3.7% academic effort and 5% summer effort (or 4% calendar effort)
Supporting Agency: NIH, 1R21EY031271 (PI-Parker)
Name and Address of Funding Agency's Procuring Contracting/Grants Officer:

Ashley R Dash, Grants Management Specialist
NIH
dashar@mail.nih.gov

Performance Period: 9/1/20-8/31/22

Level of Funding: total cost

Goals/Aims: The objective is to develop and test novel electrode materials for brain stimulation and recording.

Identify where projects overlap or parallel: None

Title: Pudendal neuromodulation for urinary and fecal incontinence and sphincter dyssynergia

Time commitments: 3.8% academic effort and 4% summer effort (or 3.8% calendar effort)

Supporting Agency: Dignify Therapeutics, NIH prime, R44NS115169 (PI-Thor)

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Karol B. Thor
Dignify Therapeutics, LLC
PO Box 13169, 2 Davis Dr
Research Triangle Park, NC 27709

Performance Period: 9/30/20-12/31/2021

Level of Funding: total cost

Goals/Aims: Our objective is to conduct in vivo studies of a novel approach to treat urinary incontinence and poor bladder emptying following spinal cord injury (SCI).

Identify where projects overlap or parallel: None

Title: Realistic Measurements of tDCS-Modulated Activity and Electric Fields in the Human Brain In Vivo

Time Commitments: 1% academic and 1% summer effort (or 1% calendar effort)

Supporting Agency: NIH, R03HD094614 (PI-Chhatbar)

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Program Officer
Ralph Nitkin, Ph.D.
National Center for Medical Rehabilitation Research (NCMRR) NIH Emailnitkinr@mail.nih.gov
Phone301 402 4206
Fax301 480 3854
LocationBG 6710B RM 2116
6710B ROCKLEDGE DRIVE
BETHESDA MD 20817

Performance Period: 9/1/19-8/31/22

Level of Funding: total cost

Goals/Aims: The goal of this project is to measure the electric fields generated within the human brain by tDCS and the effects of those fields on neural activity.

Identify where projects overlap or parallel: None. Ends before SC200190 will begin.

Title: Biomimetic Somatosensory Feedback Through Intracortical Microstimulation

Time Commitments: 5% academic and 5% summer effort (or 5% calendar effort)

Supporting Agency: Northwestern University (prime sponsor, NIH 5R01NS095251)

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Janet Maher

750 N Lake Shore Dr., 7th floor
Chicago, IL 60611-4579

Performance Period: 6/1/16-5/31/21
Level of Funding: total cost
Goals/Aims: The objective is to develop and test approaches to evoke meaningful tactile and proprioceptive percepts through intracortical microstimulation (ICMS) of the primary somatosensory cortex using a biomimetic approach.

Identify where projects overlap or parallel: None. Ends before SC200190 will begin.

Title: Computational localization of the epileptic focus for resection surgery
Time Commitments: 0 effort, effort not allowed by sponsor
Supporting Agency: Duke MedX
Name and Address of the Funding Agency's Procuring Contracting/Grants Officer: Duke University
Performance Period: 10/1/20-9/31/21
Level of Funding: total cost
Goals/Aims: The objective to develop and evaluate software tools to improve epileptogenic zone localization.

Identify where projects overlap or parallel: None

Title: Functional Dissection of Therapeutic Deep Brain Stimulation Circuitry
Time Commitments: 3.2% academic (or 2.4% calendar effort)
Supporting Agency: University of North Carolina-CH (Prime sponsor, NIH 1R01NS091236)
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Barbara Entwisle, Fiscal Officer
UNC Office of Sponsored Research
104 Airport Drive, Suite 2200, CB #1350
Chapel Hill, NC 27599
Performance Period: 5/15/15-4/30/21, currently in no-cost extension
Level of Funding: total cost
Goals: The objective of this project is to determine the brain circuits and specific neural elements modulated by therapeutic DBS at the subthalamic nucleus (STN), the most common target of deep brain stimulation for Parkinson's disease.
Aims: Implantation of optical stimulating fibers, cannulae, and electrical recording electrodes in rats; recording the behavioral and electrophysiological effects of optogenetic deep brain stimulation; and conducting post-mortem histology to verify dopaminergic lesions and electrode positioning.

Identify where projects overlap or parallel: None. Ends before SC200190 will begin.

Title: Bioelectronic Rescue of Cognitive Impairment after Surgery
Time Commitments: 2% academic (or 1.5% calendar effort)
Supporting Agency: NIH, 1R21AG055877 (PI-Terrando)
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Grants Management Specialist: Kathleen Moy
Email: moyk@mail.nih.gov

Performance Period: 7/1/18-3/31/21, in no-cost extension
Level of Funding: annual total cost
Goals/Aims: The objective is to determine the efficacy of electrical vagus nerve stimulation (VNS) to activate the cholinergic anti-inflammatory reflex as a treatment for post operative cognitive decline.
Identify where projects overlap or parallel: None

Title: Sacral Nerve Stimulation to Treat Detrusor Underactivity: Parameters and Pathways
Time Commitments: 2.7% summer effort (or 1% calendar effort)
Supporting Agency: Medtronic
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Lance Zirpel, PhD
Chief Scientist-Pelvic Health & Gastric Therapies
Medtronic, Inc
7000 Central Avenue NE
Minneapolis, Minnesota 55432-3576
Lance.zirpel@medtronic.com
Performance Period: 11/19/19-1/8/21
Level of Funding: total cost
Goals/Aims: The objective of this grant is to quantify the effects of sacral nerve stimulation parameters on voiding in the obese prone rat model of urinary retention.
Identify where projects overlap or parallel: None

Title: Modeling Selective Vagus Nerve Stimulation
Time Commitments: 5% summer effort (or 1.3% calendar effort)
Supporting Agency: LivaNova
Name and Address of the Funding Agency's Procuring Contracting/Grants Officer:
Ryan Verner, 3rd floor clinical
100 Cyberonics Boulevard
Houston, TX 77058 USA
Performance Period: 6/1/19-8/31/20, currently in no-cost extension
Level of Funding: total cost
Goals/Aims: The objective is analyze electrode designs that enable selective stimulation of the human vagus nerve.
Identify where projects overlap or parallel: None

Title: Evaluation of Efficiency and Selectivity of a Novel Computational Model of Spinal Cord Stimulation for Chronic Pain
Time Commitments: 2% academic effort (or 1.5% calendar effort)
Supporting Agency: VA CSR&D MERIT REVIEW AWARD 1I01CX001413-01
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
effort is provided through a Duke department
Judith Bukenya
Grants Manager
Judith.bukenya@duke.edu
Performance Period: 2/1/19-1/31/21

Level of Funding: annual direct

Goals/Aims: The objective of this project is to determine the feasibility of using patient-specific computational models of spinal cord stimulation to select stimulation parameters that provide better pain relief.

Identify where projects overlap or parallel: None

Title: Rational Design of TMS for Neuromodulation

Time Commitments: 1.5% academic (or 1.2% calendar effort)

Supporting Agency: NIH, R01NS08867 (PI-Marc Sommer)

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Denise Chatman, Grant Management Specialist
National Institute of Neurological Disorders and Stroke
6001 Executive Boulevard, Suite 3290, MSC 9537
Bethesda, MD 20892
chatmand@ninds.nih.gov

Performance Period: 8/15/14-6/30/20

Level of Funding: total cost, in NCE

Goals: The objective of this project is conduct simultaneous single unit recordings and behavioral measurements to quantify and optimize the effects of transcranial magnetic stimulation.

Aims: 1) We will vary the *temporal* parameters of TMS, 2) We will vary the *spatial* parameters of TMS using various coil locations and types of stimulation coils, including macaque-scaled approximations to conventional figure-8 coils as well as less focal coils recently approved for depression treatment (H coils).

Identify where projects overlap or parallel: None

Title: Closed-Loop Neural Sensing and Stimulation System for Small Animals

Time Commitments: 4% academic effort (or 3% calendar effort)

Supporting Agency: MicroLeads, Inc ; prime NIH R43OD024448

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Bryan McLaughlin, PhD
8 Saint Mary's Street Suite 625
Boston, MA 02215-2421
bryan@micro-leads.com

Performance Period: 7/1/17-12/31/19

Level of Funding: total cost

Goals/Aims: The objective of this project is to develop and test a wireless implantable stimulation and recording system.

Identify where projects overlap or parallel: None

Title: Peripheral nerves stimulation to treat bladder dysfunction (Stage 2)

Time Commitments: 4.6% academic effort (or 3.5% calendar effort)

Supporting Agency: Galvani Bioelectronics Limited

Name and address of the Funding Agency's Procuring Contracting/Grants Officer:

Kristoffer Famm
980 Great West Road
Brentford, Middlesex TW8 9GS, UK

Performance Period: 4/1/16-12/31/19
Level of Funding: total cost
Goals/Aims: The objective of this project is to determine the effect of peripheral nerves stimulation on the symptoms of overactive bladder.

Identify where projects overlap or parallel: None

Title: "Functional mapping of efferent gut neuroepithelial circuits"
Time Commitments: 2% academic effort (or 1.5% calendar effort)
Supporting Agency: NIH, 1OT2-OD023849 (PI-Shen)
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Felicia M Qashu
Email:
Felicia.qashe@nih.gov
Performance Period: 9/28/2016-1/31/2018
Level of Funding:
Goals/Aims: The objective of this project is to quantify the afferent and efferent innervation of the gut neuroepithelium.

Identify where projects overlap or parallel: None

Title: Improved Electrode Material for Deep Brain Stimulation
Time Commitments: 2.6% academic (or 2% calendar effort)
Supporting Agency: Platinum Group Coatings, LLC (Prime award, NIH R44NS083183)
Name and address of the Funding Agency's Procuring Contracting/Grants Officer:
Jack Whalen, PhD CEO
2265 E Foothill Blvd
Pasadena, CA 91107
Performance Period: 12/1/15-7/31/19
Level of Funding: total cost
Goals/Aims: The objective of this project is to compare the long-term stability of EPIC electrodes and conventional platinum-iridium electrodes for DBS and both single unit and local field potential recording in the basal ganglia of parkinsonian rats.

Identify where projects overlap or parallel: None

I, PD/PI or other senior/key personnel, certify that the statements herein are true, complete and accurate to the best of my knowledge, agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award and accept the obligation to comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties.

Signature _____

Date _____

Digitally signed by Warren Grill
Date: 2022.09.23 14:52:53 -04'00'