The 8th US-Japan Digital Innovation Hub and Advanced Technology Workshop

Poster Session Abstracts

Ohio Stadium - Block O Room

Wednesday, September 11, 2024

THE OHIO STATE UNIVERSITY

Poster Topic: Artificial Intelligence

Title: Rethinking Information Privacy: A Multilevel Framework for the Digital Age

Authors: Truong "Jack" Luu, Michael Jones (University of Cincinnati)

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Faculty Advisors: Andrew Harrison, Binny M. Samuel

Abstract: We present a unified framework for understanding information privacy amid technological advances like quantum computing and artificial intelligence. By integrating multilevel perspectives of infrastructure, institutions, regulation, and individuals, it shifts focus from data flows to inference, offering a comprehensive approach to managing privacy risks in today's digital landscape.

Title: Evaluation of different machine learning approaches to downscale SMAP and NLDAS soil moisture measurements over the Contiguous United States

Author: Eshita Eva (The Ohio State University)

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Faculty Advisor: Steven Quiring

Abstract: Random forest (RF), support vector machine (SVM), and eXtreme gradient boosting (XGB) have been applied to downscale Soil Moisture Active Passive Level 4 (SMAP L4) and North American Land Data Assimilation System (NLDAS) soil moisture to 1 km resolution. Different accuracy matrices have been calculated, and based on these accuracy matrices, the best methods have been identified.

Title: Exploring the Boundaries of Creativity with Generative AI

Author: Phillip Biondo (The Ohio State University)

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Abstract: Visual communication design students explored the innovative realm of AI-generated imagery, focusing on visual narrative and composition through various prompts. Embracing the new process with enthusiasm, they investigated the intersection of technology and design. The experience also highlighted their diverse needs and concerns about using AI tools for visual creation.

Title: Achieving Sample and Computational Efficient Reinforcement Learning by Action Space Reduction via Grouping

Author: Yining Li (The Ohio State University)

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Abstract: Reinforcement learning often needs to deal with the exponential growth of states and actions when exploring optimal control in high-dimensional spaces. We address this issue by learning the inherent structure of action-wise similar MDP to balance the performance degradation versus sample/computational complexity appropriately.

Title: HARVEST: High-Performance Artificial Vision Framework for Expert Labeling using Semi-Supervised Training

Author: Nawras Alnaasan (The Ohio State University)

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Abstract: Deep Learning (DL) thrives on data; however, it inherits a major limitation—training and testing datasets must be fully annotated for supervised Deep Neural Networks (DNNs) training. To address this challenge, we introduce HARVEST-2.0, a high-performance computer-vision framework for end-to-end data preprocessing, training, inference, and visualization of computer vision tasks. HARVEST-2.0 utilizes cutting-edge semi-supervised learning algorithms requiring only a small subset of labeled data samples.

Title: Talk to the Arm: Using LLMs for Agile Industrial Robot Programming

Author: Brennan Swick (The Ohio State University)

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Abstract: This research addresses the challenge of programming industrial robots for small, frequently changing part lots. We designed a system using a Large Language Model (LLM) to generate robot process plans from natural language. Plans are visualized and simulated for verification. Though LLM performance varied, 2 input prompts resulted in successful block-stacking programs.

Title: Near-Optimal RL with Instantaneous Constraints in Non-Convex Feature Spaces

Author: Amirhossein Roknilamouki (The Ohio State University)

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Abstract: Reinforcement Learning (RL) faces challenges with instantaneous hard constraints in non-convex feature spaces, relevant in robotics and autonomous vehicles. We introduce a method for episodic linear MDPs that satisfies these constraints and achieves sublinear regret. Our approach extends previous convexity assumptions, with numerical results supporting our theoretical findings.

Title: Evaluating the deductive competence of large language models

Author: Spencer Seals (Wright State University)

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Abstract: The development of highly fluent large language models has prompted increased interest in assessing their reasoning capabilities. We investigate whether LLMs can solve a classic deductive reasoning problem and find LLMs have limited performance. Our results suggest that LLMs have unique reasoning biases not entirely predicted by human reasoning performance.

Title: BeST - A Novel Source Selection Metric for Transfer Learning with Binary Classifiers

Author: Ashutosh Soni (The Ohio State University)

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Abstract: One of the most fundamental, and yet relatively less explored, goals in transfer learning is the efficient means of selecting top candidates from a large number of previously trained learning models (optimized for various “source” tasks) that would perform the best for a new “target” task with a very limited amount of data. In this work, we undertake this goal by developing a quantization based novel task-similarity metric (BeST) that consistently performs well in identifying the most transferrable source(s) for a given task.

Title: Leveraging the Physical Layer for Differential Privacy in Over-the-Air Federated Learning

Author: Jiayu Mao (The Ohio State University)

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Abstract: Federated learning (FL) is a distributed learning framework that by design allows local edge devices to keep their training data. However, privacy leakage occurs through model updates and is a privacy protection concern that needs to be addressed. Over-the-air FL (OTA-FL) is a variant of FL designed for wireless edge networks by utilizing the inherent superposition property of the wireless medium. The wireless physical layer (PHY), in addition to providing resource and communication- efficient collaborative training via OTA-FL, can also be leveraged to enhance privacy for FL. This paper presents the PHY design to ensure differentially private (DP) OTA-FL. The convergence analysis is provided for non-convex learning objectives. Experiments conducted on real-world non-i.i.d. data demonstrate that our scheme outperforms the state-of-the-art method under the same DP requirement and illustrate the effectiveness of cooperative jammer in the case of stringent privacy requirements.

Title: Privacy-Preserving Data Linkage Across Private and Public Datasets for Collaborative Agriculture Research

Author: Osama Zafar (Case Western Reserve University)

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Abstract: Privacy concerns like price discrimination and input cost manipulation hinder data sharing and research in Digital Agriculture. We propose a solution to facilitate relationship building across public and private DA datasets in a preserving-privacy manner. It enables the identification of similar farmers, extraction, and analysis of aggregate information.

Title: Big Geospatiotemporal Data Approaches to Monitoring and Mitigating Environmental Impacts in Agriculture

Authors: Olatunde Akanbi, Jonathan Steirer, Maliesha Sumudumalie, Gabriel Ponon (Case Western Reserve University)

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Faculty Advisor: Roger French

Abstract: This research explores the application of geospatial techniques for global agricultural monitoring, integrating satellite imagery and soil data to assess crop health and soil conditions. Our approach provides actionable insights to improve agricultural productivity and sustainability, addressing food security challenges through advanced machine learning models.

Title: Automated Image Segmentation and Processing Pipeline Applied to X-ray Computed Tomography Studies of Pitting Corrosion in Aluminum Wires

Author: Maliesha Sumudumalie Kalutotage (Case Western Reserve University)

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Faculty Advisor: Roger French

Abstract: To address manual segmentation challenges in XCT, we developed an automated deep learning pipeline for large-scale analysis of 1100 Al exposed to NaCl. This pipeline allows efficient pit segmentation, 3D reconstruction, and statistical characterization, offering new insights into pitting corrosion and accelerating corrosion research.

Poster Topic: Semiconductors

Title: Magnetothermopower of a Nodal Line Semimetal

Author: Poulomi Chakraborty (The Ohio State University)

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Abstract: Here, we consider whether a similar enhancement arises in nodal-line semimetals, for which the conduction and valence band meet at a line or ring in momentum space. We compute the Seebeck and Nernst coefficients for arbitrary temperature and magnetic field and we find a wealth of different scaling regimes. Most strikingly, when a sufficiently strong magnetic field is applied along the direction of a straight nodal line or in the plane of a nodal ring, the large degeneracy of states leads to a large linear- in-B thermopower that is temperature independent even at low temperatures. Our results suggest that nodal-line semimetals may offer significant opportunity for efficient low-temperature thermoelectrics.

Title: Bi2Te3: Tip-Induced Bi Bilayer Formation and Low-Dimensional Symmetry of Fcc-Fe Adsorption

Author: Duy Nguyen (The Ohio State University)

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Faculty Advisor: Jay Gupta

Abstract: Our scanning tunneling microscopy (STM) studies on Bi2Te3 reveal the controlled formation of Bi(111) bilayers through tip-induced pulses and uncover the low-dimensional symmetry of Fcc-Fe adsorption. This work provides new insights into the surface characteristics of Bi2Te3, a well-known topological insulator, and the alignment between Fe's d orbital symmetry and the hexagonal lattice symmetry of the Bi2Te3 surface.

Title: Bi-Layered Silicon with Strain-Induced Tunable Optical Properties for IR Applications

Author: Nihal Narra (Wright State University)

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Faculty Advisors: Zhuang Yan, Huang Hong

Abstract: Bilayer silicon finds a variety of applications with its wide range optical and electrical properties. Exceeding a strain threshold of 12.26% will open-up bandgaps resulting an induced inter-band optical transitions at mid infrared wavelengths and increase in refractive index.

Title: DFT Studies on Staining Engineering of Bilayer Silicene for Band Opening

Author: Reda Ahnouch (Wright State University)

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Faculty Advisors: Zhuang Yan, Huang Hong

Abstract: Opening energy bandgap of silicene is critical to grant its digital applications. We have performed computational studies and determined the structural and electronic band characteristics of 1) free-standing bilayer silicene (BLSi) under biaxial tensile strain, 2) BLSi on different substrates, 3) BLSi on GaSb with an interlayer or an airgap.

Title: Molecular Beam Epitaxy of WSe2 and MoSe2 on c-Sapphire

Author: Matthew Swann (The Ohio State University)

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Faculty Advisor: Rolan Kawakami

Abstract: Two-dimensional van der Waals materials lack dangling bonds and show relative resistance to short-channel effects in comparison with 3D materials. We demonstrate the controlled growth of highly crystalline MoSe2 and WSe2 via Molecular Beam Epitaxy. We highlight the apparent quality with the observation of RHEED Oscillations, SHG, and other data.

Title: Development of MBE Grown III-N Based High Performance Light Emitters

Author: Arnob Ghosh, Sk Shafaat Saud Nikor (The Ohio State University)

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Abstract: In this work, an ultraviolet laser-epistack featuring an AlGaN/GaN quantum well and homojunction tunnel junction was optimized for enhanced-photoluminescence at 355 nm. Additionally, a comparison of InGaN quantum disks grown on both Ga- and N-polar GaN-templates revealed superior geometric control, increased indium incorporation, and improved structural characteristics in N-polar GaN.

Title: Radiation TID and Traps Effects in Al2O3/Ga2O3 MIS Capacitors

Author: Quinn Shuai (The Ohio State University)

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Faculty Advisor: Steven Ringel

Abstract: This work investigates displacement damage (DD) and total ionizing dose effect (TID) effects in Al2O3/Ga2O3 MIS capacitors by comparing proton and x-ray irradiation effects on electrical properties using capacitance-voltage (C-V) analyses. Results suggest that TID effect is minimized when devices are put into forward bias condition.

Title: Advances in GaAsP Top cells for use in GaAsP/Si Tandems

Author: Lauren Kaliszewski (The Ohio State University)

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Faculty Advisor: Tyler Grassman

Abstract: Advances in III-V/Si metamorphic heteroepitaxy techniques have enabled efficiency improvements in a GaAs0.75P0.25 top cell for III-V on Si tandem solar cells. This was made possible by dislocation reduction, a graded base layer dopant profile, and development of an improved back surface field design.

Title: Demonstration of β-(Al,Ga)2O3 metal-semiconductor field-effect transistors with low contacts resistance and high drain current density

Author: Ryo Morita (University of Tsukuba)

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Abstract: Power semiconductor devices based on β-$(Al,Ga)_2O_3$ are promising for high-power applications due to their high breakdown field compared to other wide bandgap materials. This study reports on the development of device fabrication technology and electrical properties of β-$(Al,Ga)_2O_3$-based MESFETs, which show the highest recorded performance among reported devices.

Title: Optical Properties of Low-Defect Large-Area h-BN for Quantum Applications

Author: Shrivatch Sankar (The Ohio State University)

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Faculty Advisor: Shamsul Arafin

Abstract: This study investigates the optical properties of large-area multilayer hexagonal boron nitride (h-BN) grown on sapphire via metal-organic chemical vapor deposition. Spectroscopic analysis reveals few clustered defects with a low concentration of ?10^4 cm?2. Post-annealing, defect levels remain stable. New findings include an optically active boron vacancy and a novel carbon impurity-related defect, advancing insights into h-BN's potential in quantum information science.

Title: Reliability Investigation and Screening Technology for the Gate Oxide in Commercial SiC power MOSFETs

Author: Monikuntala Bhattacharya, Michael Jin (The Ohio State University)

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Faculty Advisor: Anant Agrawal

Abstract: Silicon carbide (SiC) MOSFETs are becoming increasingly popular for high-power electronic applications. In order to utilize SiC power MOSFETs, the reliability and robustness of the devices have become a topic of concern among researchers. This poster elaborates on the gate oxide reliability technique of SiC MOSFETs.

Title: SiC Schottky Diode for Radiation Detection

Author: Michael Jin, Monikuntala Bhattacharya, Hengyu Yu (The Ohio State University)

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Faculty Advisor: Anant Agrawal

Abstract: As a Wide-BandGap (WBG) semiconductor, SiC has increased performance and reliability for neutron/radiation detection applications when compared to Si: higher critical electric field, operating temperature range, radiation hardness, and lower dark current. This makes it an ideal candidate for radiation detectors to improve upon current Si-based detectors.

Title: Computational study of metal contact formation with 2D MoS2 to optimize transistor performance

Authors: Ashrujit Sarkar, Bowen Yu (The Ohio State University)

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Faculty Advisor: Wolfgang Windl

Abstract: High performance of 2D material-based FETs is inhibited by high contact resistance between metal-semiconductor. In this computational study, we investigate the chemical stability of Cr metal contact with 2D MoS2. Also, for a bunch of potential metals, we study adhesion energy with 2D MoS2 to look for optimum metal contacts.

Title: Characterization of Traps in High-Al AlGaN

Author: Dongseop Lee (The Ohio State University)

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Faculty Advisors: Steven Ringel, Aaron Arehart

Abstract: High-Al AlGaN is relatively immature with few defect studies but predictions of many defects, like DX centers, that may form. Here, defects in Al0.85Ga0.15N were characterized using deep level

transient and optical spectroscopies (DLTS/DLOS), which allow for quantitative analysis of trap concentration and energies across the entire bandgap.

Title: A Comparison of CdS and Zn(O,S) Buffer Layers in (Ag,Cu)(In,Ga)Se2 Solar Cells

Author: Michael Miller (The Ohio State University)

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Faculty Advisor: Aaron Arehart

Abstract: Cu(In,Ga)Se2 solar cells are an established, high- efficiency technology for utility-scale photovoltaics. However, their buffer layer is made of CdS, which is non-optimal and leads to efficiency loss. Here, we investigate Ag-alloyed Cu(In,Ga)Se2 solar cells with CdS and an alternative Zn(O,S) layer, and find that Zn(O,S) offers pathways to improved efficiency.

Title: Goniopolar Materials for Semiconductor-Based Thermoelectrics in High-Efficiency Generators

Authors: Bowen Yu, Ashrujit Sarkar (The Ohio State University)

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Faculty Advisor: Wolfgang Windl

Abstract: Addressing energy loss in industrial processes, this research focuses on goniopolar semiconductors for thermoelectric generators (TEGs). These materials, like Re_4Si_7, offer potential to reduce thermal and electrical losses through anisotropic electrical properties. Using computational tools, this study will discover goniopolar semiconductors for thermoelectric generators with enhanced efficiency.

Title: Radiometric Characterization of InGaAsSb/AlGaSb pBn Short Wave Infrared Detector

Authors: Neha Nooman, Manisha Muduli, Sophie Mills (The Ohio State University)

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Faculty Advisor: Sanjay Krishna

Abstract: Photodetectors operating in the Short-Wave Infrared (SWIR) region are useful for a wide range of applications, including medical diagnosis, remote sensing, night vision, and defense. Barrier architecture photodetectors offers enhanced performance metrics such as higher sensitivity and lower dark current. In this work, we demonstrate the material and device characterization of barrier

architecture infrared photodetectors. Electrical characterizations of the fabricated devices were performed to analyze the dominant dark current mechanism and the overall performance metrics.. A comparison of our device with the state-of-the-art detectors highlights the performance advantages of our design. These results show that InGaAsSb is a highly promising material for e-SWIR detection.

Title: Radiometric Characterization of Antimonide based Extended Short Wave Infrared (eSWIR) APDs

Authors: Sophie Mills, Manisha Muduli, Neha Nooman (The Ohio State University)

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Faculty Advisor: Sanjay Krishna

Abstract: This study presents a radiometric characterization system for SACM (Separate Absorption, Change, and Multiplication) Avalanche PhotoDiodes (APDs), emphasizing noise characteristics, quantum efficiency (QE), gain, and gain-optical power saturation effects. The system employs a modulated laser source transmitted through an optical fiber, enabling control over incident optical power.

Title: Heterogeneously Integrated GaAsSb/Si Photodiodes with an Active Interface

Authors: Manisa Muduli, Neha Nooman, Sophie Mills (The Ohio State University)

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Faculty Advisor: Sanjay Krishna

Abstract: Integrating GaAsSb with silicon combines silicon's high multiplication and low noise with GaAsSb's superior SWIR optical performance. We transfer print GaAsSb membranes onto Si to create PIN diodes, then analyze their quality and electronic properties using microscopy and electrical measurements, focusing on interface analysis.

Title: Thermoelectric properties and defects formation in Mg2Sn(Ge) epitaxial thin films grown with high Mg flux rate

Author: Kenneth Sandos (University of Tsukuba)

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Abstract: Miniaturized thermoelectric (TE) devices based on Mg2Sn(Ge) thin films are promising for IoT applications by converting waste heat into energy. The study explores how varying Mg flux rates during molecular beam epitaxy (MBE) impacts film quality, defects formation, and thermoelectric properties, particularly in Ge-alloyed Mg2Sn epitaxial films.

Poster Topic: Quantum Computing

Title: Chemically Engineering V(IV) Complexes for Application in Quantum Computing

Author: Roxanna Martinez (The Ohio State University)

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Abstract: Molecular complexes are promising candidates for use as quantum bits for quantum computing and information processing. Molecules have the advantage of synthetic tunability and reproducibility to control and understand relaxation times (T1/T2). In this poster a series of V(IV) triscatecholate complexes are studied and characterized through CW-EPR and pulsed EPR.

Title: Development of a multifunctional microfluidic platform for quantum biosensing

Author: Lawal Adebayo (Case Western Reserve University)

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Abstract: We describe the design, fabrication, and characterization of a platform for nanoscale quantum sensing of temperature and magnetic fields in a microfluidic environment using defect spin qubits. Using a 10-micron-wide microstripline as a magnetic or thermal source, we can characterize device performance on scales relevant for single-cell biosensing.

Title: Quantum MNIST: An Exploration of QNN Designs

Author: Erika Goetz (The Ohio State University)

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Abstract: Many quantum neural network designs have been proposed for solving MNIST but few have been rigorously compared with those of other authors. We develop a framework to compare QNN efficiency and design over the entire hybrid QNN pipeline. Preliminary results indicate ansatz performance is heavily influenced by preprocessing and classical-quantum data conversion.

Poster Topic: Space Transportation

Title: On Improved Dynamic Modeling for Space Travel

Author: Mark Wolf (The Ohio State University)

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Abstract: High-fidelity orbit forecasting of space assets is imperative given the rapid increase in space activity over the past several years. To advance this objective, various aspects of solar radiation pressure perturbation have been investigated using numerical techniques to determine the feasibility of estimating a satellite's area-to-mass ratio.

Title: Cabin Atmosphere Filtration using Ambient Air Ionization

Author: Ian Harris (The Ohio State University)

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Abstract: In microgravity environments, microbe growth is difficult to mitigate. Excess microbial growth can lead to damage of materials, harm astronauts' health, and endanger the mission. Ambient air ionization is a potential solution to this problem and from initial testing, it has shown to have had an impact on yeast growth in potato dextrose agar plates.

Title: An Inquiry of the Effects of the Earth's Magnetotail on the Lunar Surface

Authors: Adil Jamal, Sai Vidyud Senthil Nathan, Hanshu Kotta, Tej Somi Reddy, Kasim Memon (The Ohio State University)

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Faculty Advisor: John Horack

Abstract: Due to the limited understanding of lunar space weather, the OSU GLEE Team is developing an Arduino microcontroller (LunaSat) to measure magnetic and capacitance variations during different lunar orbit periods. The conclusion of this research will provide insights into potential water formation and aid in future lunar robotic missions.

Title: Benefits of Nuclear Thermal Propulsion to Advance Space Travel

Author: Spencer Christian (The Ohio State University)

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Faculty Advisor: John Horack

Abstract: Future missions to Mars and beyond require high efficiency and fast travel times to reduce overall mission cost and lower risk to crew health. Fortunately, Nuclear Thermal Propulsion offers twice the efficiency and significantly shorter travel times than chemical rockets, making NTP an attractive technology for future crewed missions.

Title: Detection of Asthma Inhaler Use for Space Medicine Applications via Terahertz Spectroscopy

Author: Daniel Tyree (Wright State University)

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Faculty Advisor: Ivan Medvedev

Abstract: Extended human space transportation will require highly sensitive and specific diagnostic tools. Terahertz rotational spectroscopic sensing of biofluids can satisfy these needs. We demonstrate medical breath sensing by detecting the presence of propellant from a pulsed dose medical inhaler in exhaled breath up to 30 minutes post inhaler use.

Title: Materials Joining in Space

Author: Eugene Choi (The Ohio State University)

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Abstract: Development and testing of self contained laser welding system developed by student. NASA-OSU CAN (Cooperative Agreement Notice) project to enable study of welding and additive manufacturing in space environment.

Title: Investigation of the Mars Science Helicopter's Rotor Performance

Authors: Sage Herz, Anthony Pisano, Harrison Childre, Jace Park (The Ohio State University)

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Abstract: There is no known correction to BEMT for compressible, low Reynolds number rotor flow. Seeking one is the ultimate goal of this research investigation so that rapid, iterative rotor designs can be assessed for Martian flight vehicles. BEMT and experimental results are compared against each other in terms of Torque Coefficient, CQ, and Blade Pitch, θ. Future testing of the MSH rotors in analogous Mars atmospheric conditions will take place at OSU's Aerospace Research Center's LRF vacuum chamber.