

Michigan Tech Aerospace Engineering Research Center (MARC)

Michigan Technological University

Annual Report FY2023

Director:

Greg Odegard – MEEM

Statement of Purpose

To establish Michigan Tech as a leader in aerospace engineering research and education

Mission Statement

The institute will serve as a focal point at Michigan Tech for activities related to Aerospace Engineering. Specifically, the institute will

- Enable world-class research
- Foster undergraduate and graduate educational programs

The Center is constituted with four sub-centers:

- CRE³ST: Center for Robotics on Earth, Extreme Environments and Space Technology
- CODES: Center for Control, Optimization and Dynamics of Energy Systems
- CAMS: Center for Aerospace Materials and Structures
- CMuST: Center for Multiscale Technologies

Each sub-center also has a Director, who also must be a voting member (unless they are non-voting at the time of the inception of this charter), and are installed, renewed, or removed by a simple majority vote of voting members by ballot. Terms of sub-center Directors are indefinite, and should a sub-center Director not be able to continue in their role, a temporary sub-center Director may be appointed by the MARC Director. The sub-center Directors are responsible for the distribution of the funds that are allocated to their respective sub-centers

Membership

Membership in the Center is open to all faculty, staff, postdoctoral associates, and adjunct faculty participating in research and graduate education in the subject area. Members are classified as Voting or Affiliated.

Voting members are limited to those members serving as Principal Investigator, Co-Principal Investigator or Official Collaborator on extramural projects that generate overhead return to the center of \$2,000 or more on an annual basis (based on activities in the current and preceding Michigan Tech fiscal years). An Official Collaborator contributes to the scientific development or execution of the project in a substantive, measurable way and has attached a letter of collaboration to an extramurally funded grant at the time of submission that generates overhead return if awarded, but they are not listed as a Co-Principal Investigator on the grant cover sheet. Voting membership may also be granted to faculty and staff that directly support Center activities through other funding avenues at the discretion of center leadership.

Affiliated members are those that do not qualify as a voting member. Affiliated members can participate in Center activities, but cannot vote on the allocation of Center resources, appointment of the Director, changes in the Center Charter, or any other action that requires a formal vote by the voting members.

The current members are:

- Greg Odegard – Center Director (MEEM)
- Brad King (MEEM)
- Trisha Sain (MEEM)
- Paul van Susante (MEEM)
- Kazuya Tajiri (MEEM)
- Wayne Weaver (MEEM)
- Jason Blough (MEEM)
- Jeff Allen (MEEM)
- Vinh Nguyen (MEEM)

The members of MARC will be engaged through a regular strategic planning meeting in which we will discuss funding opportunities, resource utilization, IRAD return usage, and research collaboration. The goal of these meetings will be to use our resources in the best manner to facilitate the members’ research success and the growth of aerospace engineering research at Michigan Tech. While no new members joined during the past year, the existing members have been successful in garnering new research funding under the center.

Major facilities/projects

Planetary Surface Technology Development Lab (PSTD), aka Huskyworks

- Director: Paul van Susante
- Location: MEEM 701A and Benedict Lab U112

Website: <http://www.huskyworks.space/>

Ultra-Strong Composites by Computational Design (US-COMP)

- Director: Greg Odegard
- Website: <http://www.us-comp.com/>

National Institute of Standards and Technology – Professional Research Program (NIST PREP)

- PREP Manager: Greg Odegard
- PREP Coordinator: Vinh Nguyen
- Website: <https://www.mtu.edu/nist-prep/>

IRAD return usage

In FY 2023 MARC used IRAD return for the following items:

- | | |
|-----------------------------------------------------------|-----------|
| • Salaries and Wages (Research and Marketing Coordinator) | \$ 14,054 |
| • Fringe Benefits | \$ 5,987 |
| • Services (Minerals and Materials) | \$ 200 |

Total IRAD Expenditures	\$ 20,241
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Strategic planning

MARC plans to continue investing funds in part-time staff support. With the significant number of grants coming through MARC, there is a need to have help with financial management. For FY 2022-23 we prototyped an approach for using MEEM’s Coordinator of Research and Marketing (Donna Jenó-Amici) for this support. We covered 20% of her time during this period, with MEEM covering the rest. This approach was very successful with helping Paul van Susante manage his numerous grants, which allows him more time to write more proposals. Donna has also helped with the budgeting and proposal forms for several other proposals going through MARC. This is proving to be a strategically beneficial use of MARC IRAD funds, which ultimately will help us to grow further.

The MARC members also plan to strategically invest MARC funds in improving our equipment infrastructure to enable more aerospace engineering related research funding. This is an important goal for FY 2023-24 and 2024-25. We plan to identify key items that we need to purchase/build for continued growth of our research contracts.

Total Center Proposals Submitted & Awards Per FY

	FY19	FY20	FY21	FY22	FY23
Number of PI's who submitted	3	12	3	5	19
Total requested amount	\$1,354,629	\$4,347,348	\$6,823,005	\$7,322,017	\$25,831,008
	FY19	FY20	FY21	FY22	FY23
Number of PI's who were awarded	2	2	1	3	12
Total award amount	\$5,117,712	\$4,165,912	\$1,310,043	\$3,694,966	\$4,981,870

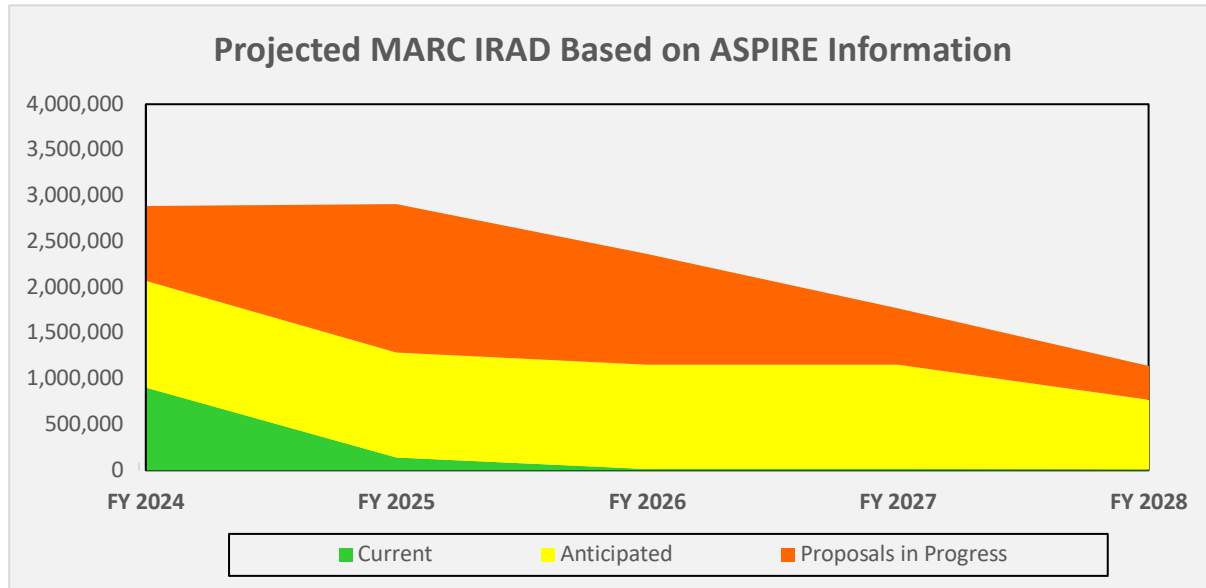
Source: MARC Awards and Proposals spreadsheet for report FY (requested from VPR, Manager of Business Systems). Includes former centers AIM and MUSTI, which have been reorganized under MARC.

IRAD Fund Income and Use Per Fiscal Year

Expenditures		FY19	FY20	FY21	FY22	FY23
	Salaries and Wages	\$0.00	\$0.00	\$0.00	\$0.00	\$14,053.91
	Fringe Benefits	\$0.00	\$0.00	\$0.00	\$0.00	\$5,987.03
	Services	\$0.00	\$0.00	\$0.00	\$4,840.00	\$200.00
	Supplies	\$0.00	\$0.00	\$27,338.00	\$4,108.07	\$0.00
	Equipment	\$0.00	\$5,000.00	\$0.00	\$0.00	\$0.00
	Travel	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Transfers Out	\$0.00	\$12,000.00	\$5,000.00	\$1,000.00	\$0.00
	Designated Fund Fee	\$389.98	\$0.00	\$0.00	\$0.00	\$0.00
	Total Expenditures	\$389.98	\$17,000.00	\$32,338.00	\$9,948.07	\$20,240.94
Income						
	IRAD	\$27,121.10	\$29,128.03	\$26,800.53	\$57,351.67	\$93,857.95
	PI Transfers	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Other	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Total Income	\$27,121.10	\$29,128.03	\$26,800.53	\$57,351.67	\$93,857.95
	Carryforward	\$0.00	\$26,731.12	\$38,859.15	\$33,323.68	\$80,727.28
	End FY Balance	\$26,731.12	\$38,859.15	\$33,321.68	\$80,727.28	\$154,344.29

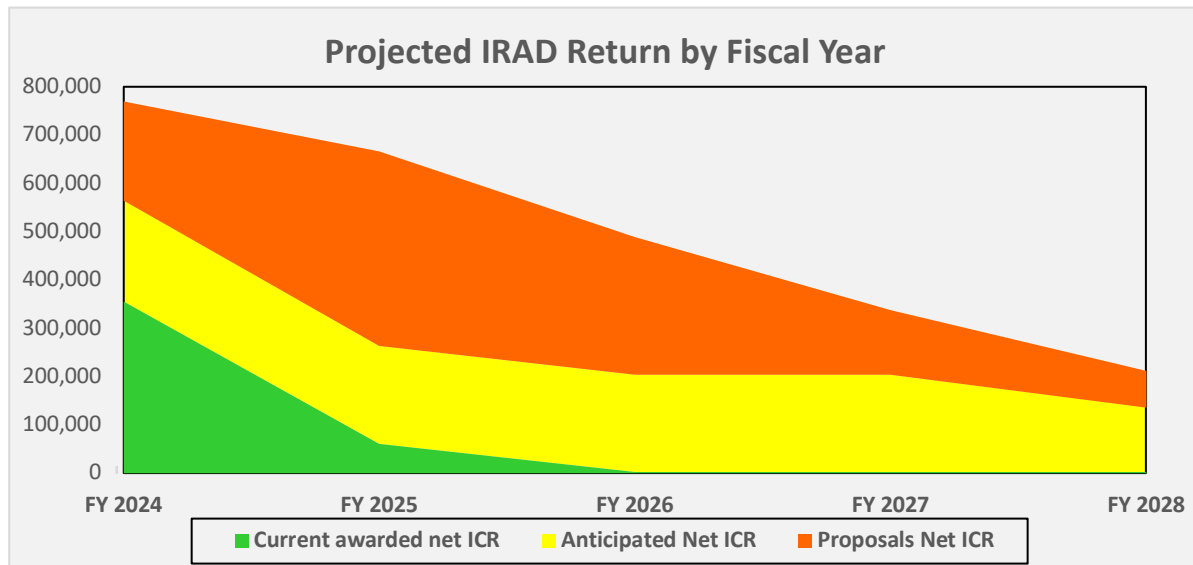
Source: WebFocus Financial Reports, Budget vs. Actual for index E35519, FY2023.

Projections



\$ by Fiscal Year (FY)	FY					Total
	FY 2024	FY 2025	FY 2026	FY 2027	2028	
Current	906,683	139,243	14,538	14,538	9,934	1,084,936
Anticipated	1,167,039	1,147,384	1,142,212	1,142,212	761,475	5,360,322
Proposals in Progress	813,202	1,622,571	1,205,101	616,021	370,722	4,627,617

Source: ASPIRE MARC Research Projection Report (Open balance). Excludes projects starting in FY24.



Projected IRAD \$ by Fiscal Year (FY)	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	Total
Current awarded net ICR	355,260	60,723	2,958	2,958	2,022	423,921
Anticipated Net ICR	209,235	202,427	200,635	200,635	133,757	946,689
Proposals Net ICR	205,057	402,631	284,907	134,014	75,619	1,102,228

Source: ASPIRE MARC Research Projection Report (Open balance). Excludes projects starting in FY24.

Active Contracts FY 23

1607060	6/15/2017	8/15/2024
Odegard, Greg, (PI: MEEM); Pandey, Ravindra, King, Julia, Sain, Trisha National Aeronautics & Space Administration <i>"Institute for Ultra-Strong Composites by Computational Design (US-COMP)"</i>		
1811081	10/15/2019	10/14/2024
van Susante, Paulus (PI: MEEM) University of Central Florida <i>"Center for Lunar and Asteroid Surface Science (NASA SSERVI CAN)"</i>		
1910057	8/1/2019	8/1/2024
Blough, Jason (PI: MEEM) Orbion Space Technology <i>"Performance and lifetime characterization of a low-power Hall-effect thruster"</i>		
2001052	7/1/2020	12/31/2022
van Susante, Paulus (PI: MEEM) Trans Astronautica Corporation <i>"NIAC Phase 2: Lunar Polar Mining Outpost"</i>		
2003066P2	7/08/2021	7/28/2022
van Susante, Paulus (PI: MEEM) National Aeronautics and Space Administration <i>"NASA GSD: Molten Regolith Electrolysis Technology Maturation"</i>		
2005067	06/01/2021	5/31/2024
Odegard, Greg (PI: MEEM) University of Massachusetts - Lowell <i>"ICME Optimization of Advanced Composite Components of the Aurora D8 Aircraft"</i>		
2009010	5/1/2021	5/09/2023
van Susante, Paulus (PI: MEEM) National Aeronautics and Space Administration <i>"Percussive Hot Cone Penetrometer (PHCP) and Ground Penetrating Radar (GPR) for Geotechnical and Volatiles Mapping"</i>		
2109018P1	5/01/2022	4/30/2024
van Susante, Paulus (PI: MEEM) Colorado School of Mines (NASA) <i>"Autonomous Lunar Landing Pad Site Preparation"</i>		
2111044P1	5/01/2022	4/30/2023
van Susante, Paulus (PI: MEEM) University of Michigan/Michigan Space Grant Consortium <i>"Lunabotics Competition Robot"</i>		

2203026P1	3/01/2022	2/28/2024
van Susante, Paulus (PI: MEEM)		
Ashwin-Ushas Corporation		
<i>"Thermal Control in Lunar Rovers and Structures with Novel Electrochromic Variable-Emissivity Skins"</i>		
2204050P1	4/18/2022	8/01/2022
van Susante, Paulus (PI: MEEM)		
Goodyear Tire & Rubber		
<i>"GM/Goodyear material testing in DTVAC"</i>		
2209080	04/01/2023	03/31/2028
Odegard, Greg (PI: MEEM)		
National Institute of Standards and Technology		
<i>"NIST Professional Research Education Program (PREP) - Gaithersburg"</i>		
23-0206	06/01/2023	12/31/2023
Morse, Stephen (PI: MEEM)		
North Star Windows		
<i>"Strength Comparison of Annealed Glass Specimens Using Four-point Bending Test"</i>		

Pending Proposals at close of FY 23

PROPOSAL NUMBER	DATE SUBMITTED	SPONSOR	PROPOSAL TITLE	START	END	AMOUNT	PI Name
2306023PP	6/7/2023	US Dept of Energy	Great Lakes Offshore Wind Center of Excellence (GLOW-CE)	1/1/2024	12/31/2028		Fernando L. Ponta
2302071P1	2/23/2023	Advanced Technology and Research Corp	Autonomous Crane system for Payload Motion Control	7/1/2023	6/30/2024	\$ 35,000	Gordon G. Parker
2209081P1	9/30/2022	US Dept of Commerce	PREP Boulder: Establishment of a NIST Boulder PREP Program at Michigan Technological University	5/1/2023	4/30/2028	\$ 3,939,959	Gregory M. Odegard
2305003P1	5/3/2023	University of Massachusetts	FMRG: ECO: Enabling the Manufacturability of the Next Generation of Fully Recyclable Wind Turbine Blades	9/5/2023	9/4/2026	\$ 298,802	Gregory M. Odegard
2212007P2	5/10/2023	Honeywell Federal Manufacturing & Technologies LLC	Simulation Methods for Optimal Fixture Design and Prediction - Modification	11/30/2022	8/31/2023	\$ 37,000	Jason R. Blough
2302003P1	2/14/2023	National Aeronautics & Space Administration	Mitigating Future Mission Risk through a Mechanistic Understanding of PCM Supercooling in Microgravity	9/1/2023	8/31/2025	\$ 100,000	Jeffrey S. Allen
2304042P1	4/24/2023	National Aeronautics & Space Administration	Unified Mission-planner Bridging Robots in Rescue and Extreme Lunar Landscape Assistance (UMBRRELLA)	1/1/2024	12/31/2025	\$ 1,999,623	Jung Yun Bae

PROPOSAL NUMBER	DATE SUBMITTED	SPONSOR	PROPOSAL TITLE	START	END	AMOUNT	PI Name
2211086PP	11/30/2022	US Dept of Defense	Boron Nitride Nanotube Arrays Embedded in Electrospun Silk Fibroin Fibers: Conformable Biocomposites for Thermal Management of Electronics	7/1/2023	6/30/2026	\$ -	Parisa Abadi
2203037P1	11/4/2022	Do Not Share	Do Not Share	5/1/2023	4/30/2025	\$ 1,318,301	Paulus J. van Susante
2211031P1	11/10/2022	Astrobotic Technology	Clear Dust Repellent Coating Tipping Point Proposal (CDRC TP)	5/15/2023	5/30/2025	\$ 15,828	Paulus J. van Susante
2211075P1	11/21/2022	Astrobotic Technology	LunaGrid-Lite: Demonstration of Tethered Scalable Lunar Power Transmission	5/15/2023	5/30/2026	\$ 20,688	Paulus J. van Susante
2211088P1	12/8/2022	University of Notre Dame	Center for Lunar Exploration and Assessment of Regolith Resources (CLEARR)	7/1/2023	6/30/2028	\$ 625,000	Paulus J. van Susante
2303025P1	3/13/2023	SpaceFactory Inc	Regolith Overburden Structures on the Moon: Design and ConOps for Emplaced Protection	7/10/2023	6/28/2024	\$ 45,000	Paulus J. van Susante
2303027P1	3/13/2023	SpaceFactory Inc	Lunar Solar Array Structure: Engineering Installation and Testing of a Deployable Foundation	6/19/2023	12/15/2024	\$ 40,000	Paulus J. van Susante
2212008PP	12/2/2022	US Dept of Energy	Water Desalination Powered by a Novel Composite Soft-Rigid Wave Energy Converter	9/1/2023	8/31/2025	\$ -	Shangyan Zou
2212009PP	12/2/2022	US Dept of Energy	Desalination Powered by Ocean Wave and Current Energy	9/1/2023	8/31/2025	\$ -	Shangyan Zou

PROPOSAL NUMBER	DATE SUBMITTED	SPONSOR	PROPOSAL TITLE	START	END	AMOUNT	PI Name
2303022P1	3/2/2023	US Dept of Energy	Desalination Powered by Ocean Wave and Current Energy	9/1/2023	8/31/2025	\$ 500,000	Shangyan Zou
2210024P1	10/11/2022	National Science Foundation	ERI: Transforming vehicular vibrations into anechoic structural waves for circulating liquid-coolant in electric vehicles	1/1/2023	12/31/2024	\$ 199,401	Sriram Malladi
2303015P1	3/10/2023	National Science Foundation	Collaborative Research: DMREF: Discovery of Intercalation Hosts for Next-Generation Multivalent Ion Batteries: An Integrated Computational-Experimental-Data Driven Approach	10/1/2023	9/30/2027	\$ 760,191	Susanta Ghosh
2305021P1	5/12/2023	US Dept of Defense	A Novel Phase-field Approach for Fatigue Damage Prediction in Fiber-reinforced Polymer Composites	1/1/2024	12/31/2026	\$ 748,481	Trisha Sain
2305026P1	5/15/2023	Washington Headquarters Sevices	Advanced Machatronics Training for Defense Manufacturing	1/1/2024	12/31/2026	\$ 2,271,112	Vinh Nguyen
2305009PP	5/5/2023	US Dept of Defense	Energy Storage System Design Based on Ship Electro-Mechanical-Thermo Operational Specifications	10/1/2023	9/30/2026	\$ -	Wayne W. Weaver