Topic: N15A-T006

Systems Technology, Inc.

Pseudospectral Optimal Control for Flight Trajectory Optimization

New and rapidly changing threat environments necessitate increased capabilities in missile and munition path following. Systems Technology, Inc. (STI) is developing missile modeling and pseudospectral optimization technologies to perform real-time path optimization to meet this challenging threat environment. This capability allows the missile to attack fixed and moving targets, change targets, and perform multi-phase missions including adapting to threats, countermeasures, etc. With a more than 60 year history, STI is an industry leader in the design, analysis and implementation of dynamic vehicle models and control methodologies that are directly applicable to this problem. Development risk is diminished through the extensive use of desktop simulations and close coordination with the relevant Program/Project Manager, Air (PMA) to establish realistic scenarios and constraints on missile performance and capabilities.

Technology Category Alignment:

Fixed Wing Vehicles (includes UAS)
High-Speed/Hypersonics
Guidance, Navigation & Control (GN&C) and Data Links

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SYSCOM: NAVAIR
Contract: N68936-17-C-0011
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68936-17-C-0011

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-719

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Systems Technology, Inc.

WHO

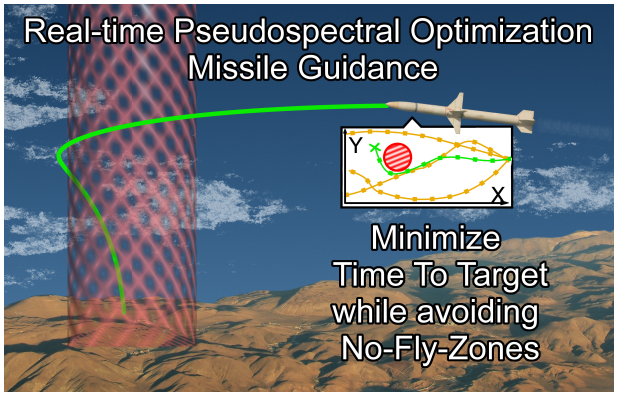
SYSCOM: NAVAIR

Sponsoring Program: PMA-242 - Direct and Time Sensitive Strike Weapons

Transition Target: Advanced Anti-Radiation Guided Missile (AARGM)

TPOC:
(760)939-4145

Other transition opportunities: Within the Navy, other transition opportunities exist under the sponsoring program (PMA-242) including the longstanding Maverick and Hellfire weapon systems. In addition, PMA-201 features the Long Range Anti-Ship Missile (LRASM) and Harpoon missile systems, both of which are powered weapon systems that could take advantage of the unique path optimization capabilities being offered here.



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WHAT

Operational Need and Improvement: New and rapidly changing threat environments necessitate increased capabilities in missile and munition path following. Therefore, there is a need for optimal trajectory guidance algorithms, as stated in the SBIR Topic objective, that can adjust a missile's path when confronted with a previously unknown threat or disturbance. This SBIR topic is sponsored under the Direct and Time Sensitive Strike Weapons Program Office (PMA-242). This work supports the needs of PMA-242 and addresses both precision strike and guided weapons systems.

Specifications Required: Requirements as stated in the SBIR Topic are to consider or be extensible to addressing: (1) increase the launch acceptable envelope, (2) provide simultaneous arrival time on target (through platform pre-coordination), (3) increase standoff range by computing optimal loft trajectory, (4) optimize terminal conditions to achieve a desired range of impacts angles or speeds or g-capability, and (5) re-compute the optimal trajectory solution for flight path deviations experienced after launch caused by phenomena such as winds or thrust mis-alignments induced by a rocket motor.

Technology Developed: The missile modeling and pseudospectral optimization technologies will provide the means to perform real-time path optimization. In essence, the technology is being developed towards having the capability to rapidly solve new targeting solutions for missile applications and updating these solutions in flight. These technologies permit the missile to attack fixed and moving targets, change targets, and perform multi-phase missions including adapting to threats, countermeasures, etc. (optimal solution includes avoiding known danger or detection zones).

Warfighter Value: This technology provides the Navy a new capability to optimize the trajectory of a missile in flight and adjust to emerging threats, countermeasures, etc. These features can be used to reduce the time to target in applicable situations, and coordinate multiple missiles or other guided weapons to achieve the target at the same time. This offers the potential to increase acceptable launch windows and conditions that might otherwise have adversely affected the capability of the weapon to strike the intended target, thereby offering the warfighter greater and potentially safer options for deploying said munition.

WHEN

Contract Number: N68936-17-C-0011 **Ending on:** January 4, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Phase II Base Program Prototype	Med	Phase II Team and Stakeholder Assessments	3	September 2018
Phase II Base Program Mission Demonstrations	High	Phase II Team and Stakeholder Assessments	4	January 2019
Phase II Option Advanced Mission Demonstrations	High	Phase II Team and Stakeholder Assessments	5	October 2019

HOW

Projected Business Model: This technology will meet Navy objectives via a purely software solution that does not require any additional hardware and would integrate with the missile's existing control software. Systems Technology, Inc. (STI) plans to transition this technology through the Prime based on the needs and requirements as dictated by PMA-242. The Prime for the AARGM is Orbital ATK. This technology is expected to be licensed or sold. STI would work with the relevant parties to identify relevant integration needs and capabilities, execute on those developments and adjustments, and provide the relevant code and necessary integration support to the Prime either as part of a support contract effort or as part of the sale.

Company Objectives: With a more than 60 year history, STI is an industry leader in the design, analysis and implementation of dynamic vehicle models and control methodologies that are directly applicable to this problem. The company objectives for the Forum for SBIR Transition event are to increase the visibility of this emerging technology beyond the sponsoring organization and to reach the broader fleet in general, extending beyond strike weapons to a more diverse community that might benefit from real-time path optimization, including UAS. These efforts will be focused on identifying the government and industry partners that are critical to supporting and advancing a Phase III commercialization pathway for this technology.

Potential Commercial Applications: Potential non-DoD commercial applications for this technology include the broader commercial UAS market including future urban air taxi operations. This technology is well suited to address environments with multiple competing constraints and non-static "threats" including other UAS, urban air taxies, aircraft, etc. This capability opens up the market to any of the 100s or more UAS and potential urban air taxi operators, offering robust flight time optimization or energy management capabilities.

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