

# Integrated Multidisciplinary Optimization Objects

## *Integrated modules for constructing and solving multidisciplinary design analysis and optimization (MDAO) problems*

OpenMDAO is an open-source MDAO framework. It is used to develop an integrated analysis and design environment for engineering challenges. This Phase II project integrated additional modules and design tools into OpenMDAO to perform discipline-specific analysis across multiple flight regimes at varying levels of fidelity. It also showcased a refined system architecture that allows the system to be less customized to a specific configuration (i.e., system and configuration separation). By delivering a capable and validated MDAO system along with a set of example applications to be used as a template for future users, this work greatly expands NASA's high-fidelity, physics-based MDAO capabilities and enables the design of revolutionary vehicles in a cost-effective manner. This proposed work complements M4 Engineering's expertise in developing modeling and simulation toolsets that solve relevant subsonic, supersonic, and hypersonic demonstration applications.

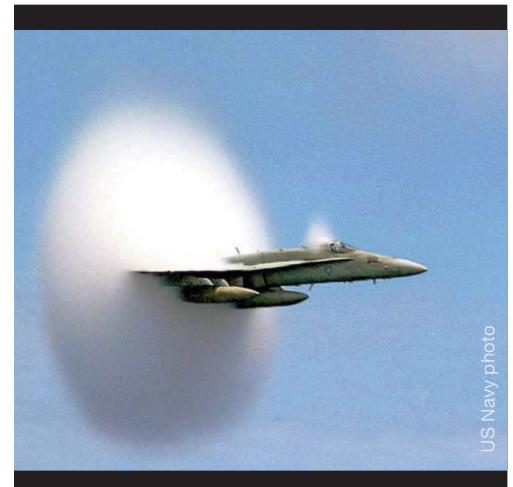
### Applications

#### NASA

- ▶ MDAO:
  - Exchange information between multiple analysis codes at multiple levels of fidelity to create models of complex systems
  - Apply state-of-the-art MDAO algorithms designed to solve highly coupled problems that arise when multiple analysis tools are combined
  - Quickly implement new tools and methods for handling complex design problems

#### Commercial

- ▶ Subsonic, supersonic, and hypersonic demonstration



### Phase II Objectives

- ▶ Establish system design
- ▶ Integrate framework-neutral software library
- ▶ Implement additional analysis modules
- ▶ Implement general-purpose modules
- ▶ Validate system with example problems

### Benefits

- ▶ Enables a much higher degree of code sharing and reuse among the MDAO community
- ▶ Provides a baseline set of modules for constructing and solving MDAO problems
- ▶ Integrates discipline-specific and common-object modules into OpenMDAO, including propulsion, noise, mission, and stability and control
- ▶ Increases the commercialization potential for sub/super/hypersonic modules and other associated products

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**Proposal Number: 08-2: A2.08-8438**