NASA SBIR 2004 Phase I Solicitation

A2.03 Revolutionary Technologies and Components for Propulsion Systems

Lead Center: GRC

NASA seeks highly innovative concepts for propulsion systems and components for advanced high-speed aerospace vehicles to support missions, such as access to space, global cruise, and high-speed transports. The main emphasis in this subtopic is on high-risk, breakthrough technologies in order to revolutionize aerospace propulsion over a broad flight spectrum, up to Mach 8. Proposals offering significant advancements in critical components and designs for propulsion systems and subsystems are sought. Specific technical areas include the following:

- Advanced cooling concepts that minimize coolant penalties can include innovative cooling systems, fuel cooling of the combustor, and endothermic fuels and/or fuel additives to increase the heat-sink capacity or cooling capacity of fuels.

- Innovative concepts relating to the combustion process, including fuel injectors, piloting, flame holding techniques for increased performance and decreased emissions, techniques to identify the onset of combustion instability in lean-burn and/or rich-burn, low NOₓ combustor, ramjet combustion and active and passive combustion controls in order to extend the operability of the combustion components to a wider range of operating conditions.

- New inlet concepts to meet functional airflow needs of high Mach number propulsion. For instance, a variable geometry, supersonic, mixed compression inlet. Compatibility with turbomachinery and mode transition across the speed range should be addressed. Special attention should be given to combustor demands along a realistic flight corridor. This flight corridor must be compatible with turbine engine thermal-structure limits.

- New techniques to improve the aerodynamic performance and operability of the inlet, including highly offset subsonic diffusers and designs for boundary layer control, minimizing engine unstart susceptibility, and techniques to identify and control the onset of mode transition between different propulsion concepts within the same internal flow path or dual flow paths.

- New controllable and reliable nozzle concepts with optimum expansion efficiency and thrust vectoring capability, including a computational nozzle design methodology to study various geometries and chemistry effects.

- Enabling technologies of components and subsystems that allow turbomachinery to operate at high-speed flight conditions. Specific examples include 1) a lightweight, high-pressure ratio compressor which must be protected or removed from the extremely high temperature primary air stream; 2) applications of micro-
electrical-mechanical systems (MEMS) that demonstrate the potential to enhance the performance and reduce the cost and weight; and 3) innovative inlet flow conditioning.

- New concepts for combined or combination cycles, in particular those including turbine propulsion. Alternate engine cycles that meet a unique mission requirement (e.g., global reach, access to space, etc.), including pulse detonation, ramjets, scramjets, and rockets. Proposals can also include development of unique components required for the maturation of alternate propulsion cycles, such as inlets, diffusers, nozzles, air valves, fuel injectors, combustors, etc.

- Innovative integration technologies among components or subsystems that significantly improve the performance or reduce the cost of the overall propulsion systems are sought. This includes new collaborative and concurrent engineering tools for analysis and design. These tools could reduce the need for empiricism, thus facilitating early evaluation of interactions among propulsion components. "Intelligent" design tools, based on technologies such as evolutionary algorithms and neural networks, are also of interest. All design/analysis tool proposals must include a propulsion technology development application.