Combined list of research opportunities of NASA Langley Research Center
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RO #18038
Advisor: Stephen Rizzi, s.a.rizzi@nasa.gov 757-864-3599
"Virtual Acoustic Simulation for Community Nois"
This research area focuses on the development of simulation tools required to render acoustic data in fully interactive, real-time environments with the goals of enhancing engineering data analysis and interpretation, and for performing subjective assessments. Particular emphasis is on developing synthesis and simulation tools for subjective testing of aircraft community noise, although other types of community noise including transportation (e.g. road and rail) and industrial (e.g. wind turbine) sources are also of interest. A multidisciplinary approach consisting of signal processing; source, propagation and receiver modeling; and virtual environment simulation is required. Computational and laboratory facilities at NASA Langley, including the newly renovated Exterior Effects Room (EER), are available for this work. Opportunity is restricted to U.S. citizens only.

RO #18041
Advisor: Ran Cabell, randolph.h.cabell@nasa.gov, 757-864-5266
" Interior Noise Control for Aerospace Vehicles"
This research is focused on the prediction and control of interior noise in advanced aerospace vehicles including rotorcraft, subsonic and supersonic aircraft, and launch vehicles. Efficient methods for structural-acoustic prediction, structural design optimization for minimum interior noise, and innovative noise control approaches are of interest. Design methods are sought that address the noise and vibration issues associated with advanced composite materials, which tend to be very stiff and lightweight. These design methods leverage the flexibility inherent to composite material constructions in order to create structurally efficient concepts with good vibroacoustic performance. The research also explores the use of novel passive and active noise control methods, such as ones using modern methods of adaptive feedforward and feedback control, and novel actuator designs including actuators incorporated into the structure, to robustly minimize the noise and vibration exposure of passengers and crew.
Opportunity is restricted to U.S. citizens only.

RO #18043

Advisor: David P. Kratz, david.p.kratz@nasa.gov, 757-864-5669

"Application of Radiative Transfer Algorithms to Satellite Data Retrievals"

Detailed analysis of the far-infrared (l> 15.4 mm or w< 650 cm-1) spectral characteristics of the Earth's atmosphere can provide a wealth of information that will further our understanding of the physics of the Earth's atmosphere. Both high resolution (monochromatic) and rapid radiative transfer (RRT) algorithms are being developed to take full advantage of the data measured at the surface, within the atmosphere, and from space using instruments either currently available or under development. This research opportunity solicits candidates who will work with the group at Langley Research Center to continue the development of radiative transfer algorithms to analyze the data provided by Fourier Transform Spectrometer (FTS) measurements. Clear-sky and cloudy-sky cases will be considered, along with pristine and aerosol burdened cases, with one of the principal foci of this effort being directed toward the analysis of far-infrared radiative effects of cirrus, which will necessitate the development of scattering routines that will make use of recently characterized far-infrared scattering coefficients based upon ice-crystal habit data.

RO #18044
Advisor: Bruce Anderson, bruce.e.anderson@nasa.gov, 757-864-5850
"Atmospheric Aerosol Characterization"
Our group conducts research to characterize the microphysical, optical and compositional properties of atmospheric aerosols and particulate matter emitted by aircraft engines. These studies involve airborne sampling as well as ground-based and laboratory measurements. Numerous objectives are pursued in this work, but the main goal is to better understand how human activities perturb the chemical and radiative character of the background atmosphere. We are also improving aerosol instrument performance and providing measurements for validating the operation of remote sensors. We maintain a large suite of in situ sampling instruments and aerosol generation equipment for use in these studies. These include sensors for determining the concentration (fine and ultrafine CN counters); size distribution (differential mobility analyzers, optical scattering, and imaging instruments); scattering and absorption properties (multi-wavelength nephelometers, aethelometers, photoacoustic spectrometer); and chemical composition (Aerosol Mass Spec, Particle-Into-Liquid Samplers, Ion chromatograph of aerosols along with an asperation generator, tube furnace, electrostatic classifiers, a vibrating orifice generator, scale model turbojet engines, and burners for creating test aerosols. Pressure, flow, and temperature control equipment and an extensive array of trace gas monitors are also available. Qualified applicants may participate in a number of new and ongoing projects sponsored by the NASA Tropospheric Composition, Radiation Sciences and Earth Venture-Class Programs and NASA Fundamental Aeronautics. Tasks associated with these efforts include extensive laboratory tests and calibrations; installation and operation of instruments in a mobile laboratory, at fixed surface sites, and onboard NASA aircraft (DC-8, Falcon UH25, and P-3B); deployments to domestic and foreign locations; reduction and archiving of data; and analysis and reporting of results.

RO #18046
Advisor: Emilie J. Siochi, emilie.j.siochi@nasa.gov,
*advisor responds best to emails only
"Biologically Inspired Smart Nanotechnology"
The objective of this research is to work at the interface of rapid advances in biotechnology, nanotechnology, and information technology to develop the materials of the future. This multidisciplinary research area requires the integration of principles of biology, chemistry, physics, and engineering to achieve revolutionary advances in materials and structures technologies. Information offered by biological systems is combined with the emerging ability to control design at the atomic level to yield new multifunctional, intelligent materials of the future. Some areas of interest include use of biomimetic synthesis methods for aerospace materials, and development of organic/inorganic hybrids, multifunctional materials, self-healing materials, self-assembling systems, and carbon nanotube reinforced nanocomposites. The research encompasses modeling, synthesis, characterization, and processing of new materials for aerospace applications.
Opportunity is restricted to U.S. citizens only.

RO #18052

Advisor: Paul M. Danehy, paul.m.danehy@nasa.gov 757-864-4737

"Development and Application of Advanced Laser-based Measurement Techniques to Transonic, Supersonic, and Hypersonic Flows"

LIDAR techniques that have important applications in areas of meteorology and atmospheric sciences are being developed for use from airborne and eventual spaceborne platforms. The first steps have been taken in this development by building and flight testing differential absorption LIDAR (DIAL) systems operating in the 720- and 815-nm wavelength regions. These systems use either Alexandrite lasers or Nd:YAG-pumped Ti:Sapphire lasers to produce tunable, narrow-line laser operation for DIAL water vapor measurements. The capability of these airborne DIAL systems will be extended to the 940-nm region, where water vapor absorption lines have line strengths a factor of 20 greater than those in the 720- or 815-nm regions. The increased water vapor absorption will permit investigation of lower water vapor concentrations in the upper troposphere and lower stratosphere. Different laser techniques for generating 940-nm laser wavelengths will be explored such as Raman shifting of the Alexandrite laser output, the use of Cr:LiSAF lasers, and OPO wavelength shifting of various lasers. Research will include laboratory investigations of laser techniques for generating laser wavelengths in regions of strong water lines. Ground-based DIAL measurements will be performed, and airborne evaluation of potential DIAL laser candidates for water vapor measurements in the 940-nm region will also be conducted. An assessment of these techniques for future space-borne water vapor experiments will be performed.

RO #18054

Advisor: Ji Su, ji.su-1@nasa.gov 757-864-8336

"Development of Electroactive Polymers (EAP) and EAP-Based Devices"

This research will focus on the development of high performance, high efficiency electroactive polymers (EAPs), particularly electromechanically active polymers by controlling molecular chemical structures and morphology. Mechanisms of electromechanical properties of EAPs will be investigated by laboratory experimental and computational studies. The research will also develop prototype devices, micro-electromechanical systems, and artificial muscles, using EAPs for aerospace applications.

RO #18058

Advisor: Ram Tripathi, ram.k.tripathi@nasa.gov 757-864-1467

"Environmental Radiation Physics"

Exposures from the hazards of severe space radiation in deep space/long duration missions are very different from that of low earth orbit, and much needs to be learned about their effects. However, it is clear that revolutionary technologies will need to be developed. Current conventional radiation protection strategy based on materials shielding is maturing and is a low earth technology. The overall situation is further augmented by the nonexistence of information about continuous radiation exposure to issues and concomitant biological uncertainties. Material shielding would have only limited or no potential for avoiding continuous exposure to radiation. Besides, current material shielding alone for radiation protection for long duration/deep space safe human space missions is prohibitive due to pay load and cost penalties and is not a viable option. We need to have "out-of-the-box" revolutionary technologies, while taking full advantage of advances in the state-of-the-art evolutionary material shielding. The breakthrough in radiation protection for long duration human space missions would have to come from biology and other interface disciplines. Active radiation shielding and novel nanotechnology are the frontiers of future space radiation protection.

RO #18159

Advisor: William Winfree, william.p.winfree@nasa.gov 757-864-4963

"Fiber-Optic Sensors for Composite Material"

In recent years, a major focus in tropospheric chemistry has been to advance the understanding of processes that impact tropospheric chemistry from local to global scales. Aircraft campaigns such as NASA's Global Tropospheric Experiment missions have collected a broad suite of atmospheric physical and chemical data to characterize regional distributions and chemical interactions of trace species. Assessments of these regional chemical environments by techniques such as diel steady state boxmodel analyses can produce estimates for budget parameters such as regional photochemical tendencies for ozone. One of the difficulties facing tropospheric chemists is the interpretation of these in-situ data on local to regional scales in the context of global satellite data. To address this issue, we are conducting research using a suite of photochemical and transport models on scales from diel steady state point models and lagrangian trajectory boxmodels to regional and global chemical/transport models.

RO #18060

Advisor: Alwyn Goodloe, a.goodloe@nasa.gov 757-864-5064

"Formal Methods for Dependable Computing"

Rigorous methods for designing and analyzing dependable computing systems are vital in digital avionics and other safety-critical applications. Continued improvements in hardware technology--together with growth trends in such areas as cockpit automation, active flight control, and digital communications--imply that avionics design complexity will rise considerably. In response to this complexity growth and the potential consequences of design flaws, formalisms and analysis techniques derived from mathematical logic are enjoying increased attention. In particular, NASA's latest initiatives in aviation safety include research on formal methods suitable for the specification, design, and verification of critical computing systems. Opportunities await those with a disciplined computing background who can advance the technology for building highly dependable hardware and software. Candidates with a balance of theoretical and tool-oriented expertise are especially welcome. Specific areas of interest include (1) formal specification and modeling languages exemplified by Statecharts, LOTOS, B, and Z; (2) mechanical theorem proving systems, particularly PVS, HOL, Coq, and ACL2; (3) model checking formalisms such as CTL* and the mu-calculus; (4) SMT solvers such as Kind, Z3, and Yices; (5) program verification systems typified by Frama-C, Verifast, and VCC; (6) static analysis approaches such as abstract interpretation and symbolic execution; (7) formal verification of numerical software; (8) logic-based runtime verification; and (9) formalisms for hybrid systems that combine discrete and continuous modeling. Moreover, applications to specialized domains are relevant, including avionics functions (e.g., flight guidance systems, airspace management algorithms, integrated modular avionics) and fault tolerance techniques (e.g., clock synchronization, Byzantine agreement).

The Center will permit both U.S. citizens and non-U.S. citizens to apply, but will decline applicants whose country of citizenship has been identified by the NASA Office of International and Interagency Relations (OIIR) as a "designated country."

RO #18065

Advisors: Alan T. Pope, alan.t.pope@nasa.gov 757-864-6642
Kara A. Latorella, k.a.latorella@nasa.gov 757-864-2030

"Human Engineering Methods for the Advanced Flight Deck"

Research is in progress to develop and refine capabilities for evaluating the design of advanced flight deck automation concepts based on the pilot's ability to maintain effective states of awareness and to remain cognizant. Research has centered on understanding the etiologies of human-automation interaction and the development of approaches to counter the onset of "hazardous states of awareness" in aerospace operations. Areas of focus have included training of pilots and air traffic controllers to learn cognitive resource management techniques to combat such states as fatigue, boredom, loss of situation awareness, and stress. Other areas have focused on new approaches to automation design including adaptive interface and adaptive automation research. Measurement technologies of interest include verbal and overt behavior monitoring, subjective response and performance measurement methods, and psychophysiological methodologies. Analytical approaches include statistical techniques, neural network analysis, and nonlinear dynamical (chaos theory) methods. Experimental facilities include quantitative electroencephalographic (EEG) and brainmapping systems, systems for peripheral measurement of autonomic nervous system function, oculometric systems, video analysis systems, statistical analysis packages, laboratory task programming system (Multi-Attribute Task Battery), full-scale flight deck simulators, neural network software, and EEG analysis systems.

Opportunity is restricted to U.S. citizens only.

RO #18067

Advisor: Stephen Hales, stephen.j.hales@nasa.gov 757-864-3128

"Innovative Manufacturing and Characterization of Light Metal Alloys"

This research will focus on innovative manufacturing processes such as near net shape forming of advanced light metal alloys. After the material is processed, metallurgical characterization and mechanical property determination will be conducted to correlate fabrication techniques with microstructure and properties. The objective is to understand metallurgy/processing/microstructure/mechanical property relationships that will lead to the advancement of light metal alloy technology. Opportunity is restricted to U.S. citizens only.

RO #18068

Advisor: Stephen Hales, stephen.j.hales@nasa.gov 757-864-3128

"Innovative Metallic Materials and Processes for Aerospace Structural Applications"

This research focuses on synthesis, processing, and characterization of advanced metallic materials for structural applications on future aircraft and launch vehicles, such as airframe skins, cryogenic tanks, and thermal protection systems. The range of materials is broad; however, the prerequisites are high specific properties and/or suitability for extreme temperature applications (-250 to 1100 C). Candidate materials include, but are not restricted to intermetallics, nanostructured materials, functionally graded materials, micro-laminates, metallic foams, and MMC's. We are also interested in coatings and surface modification techniques for environmental protection and thermal management of metallic materials. Typical studies involve establishing processing-structure-property relationships and service simulation testing. Opportunity is restricted to U.S. citizens only.

RO #18070

Advisor: Stanley S. Smeltzer, stanley.s.smeltzer@nasa.gov, 757-864-3120

"Joining Technology Development for Composite Structures"

Analytical and computational methods for rapidly and accurately predicting the response of metallic and composite structural joints are needed to determine the behavior of statically loaded aircraft and spacecraft structural concepts. As lightweight, efficient structural components are developed, they are often negatively impacted by inadequate joint analyses. This research will focus on the development and verification of semi-analytical and computational methods to perform structural tailoring of candidate joint concepts and investigate the effects of laminate anisotropy, combined mechanical and thermal loads, geometric and material nonlinearities, and fatigue on the joint response. The joint responses of selected structural concepts will be validated by conducting experiments using state-of-the-art optic and laser equipment. Opportunity is restricted to U.S. citizens only.

RO #18071

Advisors: Chris Hostetler, chris.a.hostetler@nasa.gov 757-864-3120
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Syed Ismail, syed.ismail-1@nasa.gov 757-864-2719

"LIDAR Atmospheric Measurements of Gases and Aerosols"

LIDAR techniques that have important applications in areas of meteorology and atmospheric sciences are being developed for use from airborne and eventual spaceborne platforms. The first steps have been taken in this development by building and flight testing differential absorption LIDAR (DIAL) systems operating in the 720- and 815-nm wavelength regions. These systems use either Alexandrite lasers or Nd:YAG-pumped Ti:Sapphire lasers to produce tunable, narrow-line laser operation for DIAL water vapor measurements. The capability of these airborne DIAL systems will be extended to the 940-nm region, where water vapor absorption lines have line strengths a factor of 20 greater than those in the 720- or 815-nm regions. The increased water vapor absorption will permit investigation of lower water vapor concentrations in the upper troposphere and lower stratosphere. Different laser techniques for generating 940-nm laser wavelengths will be explored such as Raman shifting of the Alexandrite laser output, the use of Cr:LiSAF lasers, and OPO wavelength shifting of various lasers. Research will include laboratory investigations of laser techniques for generating laser wavelengths in regions of strong water lines. Ground-based DIAL measurements will be performed, and airborne evaluation of potential DIAL laser candidates for water vapor measurements in the 940-nm region will also be conducted. An assessment of these techniques for future space-borne water vapor experiments will be performed.

RO #18073

Advisor: R. Jeffrey Balla, robert.j.balla@nasa.gov 757-864-4608

"Molecular Optical Diagnostics"

This research opportunity involves conception, development, and implementation of laser-based optical diagnostic techniques for quantitative and qualitative study of aerodynamic and aerothermodynamic properties of flow fields. Applications span subsonic to hypersonic velocities and cryogenic to combustion temperatures. Techniques include planar laser-induced fluorescence, degenerate four-wave mixing, laser-induced thermal acoustics, and Rayleigh and Raman scattering.

RO #18076

Advisor: Jonathan Ransom, Jonathan.B.Ransom@nasa.gov ,757-864-2907

" Non-Deterministic Design Methodologies for Aerospace Structures"

This research focuses on the development and implementation of non-deterministic design methodologies for aerospace vehicle structures. Traditional deterministic approaches to aerospace vehicle design rely heavily on factors of safety to account for various uncertainties. In contrast, non-deterministic or reliability-based design approaches implement statistical distributions of the variables of interest to quantitatively determine their effect on component and system response. This work focuses on developing advanced non-deterministic methodologies as part of an effort to develop safer, cheaper, and lighter aerospace vehicle structures.

Appointment is dependent upon availability of funding.

RO #18077

Advisor: Eric Madaras, eric.i.madaras@nasa.gov 757-864-4993

"Nondestructive Characterization of Composite Materials, Structures, and Adhesive Bond Strength"

Research opportunities exist in the areas of nondestructive characterization of composites materials and structures, which are being developed for low- and high-speed aeronautics. Some of these composites materials and structures will involve advanced, low-cost manufacturing methods, which will result in structures that are challenging for conventional test methods to measure. In the high-speed research program, composites will be exposed to extreme environmental flight conditions and require nondestructive evaluation to certify hardware during manufacture, for initial acceptance, and to monitor the integrity of the materials throughout their life. Of particular interest will be the development of robust, cost-effective non-contacting ultrasonic methods such as laser-based ultrasound techniques, as well as research to interpret the results of data. Additional opportunities exist to study adhesive bond strength. Emphasis will be placed on nondestructive methods that can measure strength related properties of adhesives.

RO #18079

Advisor: William T. Yost, william.t.yost@nasa.gov 757-864-4991

"Nondestructive Evaluation Fatigue Sensor Technology Based on Nonlinear Acoustics Concepts"

From the early stages of fatigue characterized in metals by dislocation density increases to the final stages resulting from catastrophic crack propagation, nonlinear acoustics gives some unique signatures of the steps. We are identifying the various signatures in a variety of materials including but not limited to metals, and fitting the processes with theoretically (analytically) based models of materials. We are also developing new nonlinear measurement methods and techniques for use in both the laboratory and field to assess material fatigue in aerospace structures such as airframes structures and turbine blades.

Opportunity is restricted to U.S. citizens only.

RO #18086

Advisor: Sheila Thibeault, sheila.a.thibeault@nasa.gov 757-864-4250

"Radiation Shielding Materials Theory and Development"

The goals of this research are to design, develop, and demonstrate various radiation shielding materials concepts for protecting humans and microelectronics inside aircraft, spacecraft, and Moon/Mars habitats. We have developed and are further refining fast computational codes to predict the transport characteristics of galactic cosmic radiation (GCR) and solar energetic particles (SEP). The application of these codes to innovative shielding/structural materials concepts will provide data to help us develop advanced shielding materials systems. We must select or develop materials to absorb primary incident particles from the natural environment, as well as secondary particles that arise from interactions of the primary particles with the intervening mass. Multilayered materials systems, where the different layers vary in composition and thickness, may provide a solution for shielding against the multiplicity of particles present. Multifunctional materials, where the materials provide more than one function such as structure and radiation shielding, are of primary interest.

RO #18089

Advisor: Suresh Joshi, suresh.m.joshi@nasa.gov 757-864-6608

"Robust and Adaptive Controller Synthesis Methods for Advanced Aerospace Systems"

Control of systems in the presence of uncertainties, nonlinearities, unmodeled dynamics, and component failures is a challenging problem. This is particularly true of aerospace systems including aircraft and spacecraft in flight, for which safe operation is imperative. Adding to the problem is the presence of actuator and sensor nonlinearities (saturation, rate limits, dead zone, hyeteresis), bandwidth limitations, and abrupt unknown failures and/or damage occurring at unknown instants of time. The research will involve developing rigorous theory and methodology for designing robust and adaptive control laws for such systems, that will maintain stability and maneuverability (acceptable performance) despite these problems. In the case of transport aircraft, this would mean that stability and maneuverability will be maintained despite uncertainty and impairment, and safe landing would be accomplished. The techniques to be used for controller synthesis will include but are not limited to: direct and indirect adaptive control methods; LQG-based methods, dissipativity and linear matrix inequalities, H-infinity, mu-synthesis, intelligent/fuzzy control, neural nets; and methods based on Lyapunov theory, input/output theory; and differential-geometric methods. The research will also focus on deriving rigorous theory-based stability and performance metrics for nonlinear and adaptive controllers (similar to gain and phase margins for LTI systems). The techniques will be validated by application to computer simulations and possibly to experimental hardware.

RO #18090

Advisors: Paul Stackhouse, paul.w.stackhouse@nasa.gov 757-864-5368
Pat Minnis, p.minnis@nasa.gov 757-864-5671

"Satellite, Aircraft, and Ground Observed Cloud and Radiative Flux Analyses"

Basic and applied research is being conducted in remote sensing of the Earth's cloudiness and radiative fluxes (top of atmosphere, surface, within atmosphere). Clouds are the primary modulators of the radiative energy balance of the Earth's surface and atmosphere on both local and global scales. Data sets from several satellite instruments, including CERES, ERBE, MODIS, VIIRS, CALIPSO, CloudSat, MISR, Geostationary Operational Environmental Satellite, Landsat, AVHRR, HIRS, SSM/I, will be analyzed and compared. Studies in the long-term variability of the surface, clouds, and aerosols in relationship to their effects on the radiative budget of the atmosphere and surface are performed. These studies also involve the usage of surface measurement data sets. In addition, simultaneous aircraft (e.g., SEAC4RS) and/or ground-based laser-radar measurements (e.g. ARM) will be used to examine cloud cover, cloud base and top height, optical depth, reflectance, cloud particle size, liquid and ice water path, and emissivity. Comparisons will be made with theoretical predictions of cloud generation/dissipation and with models of cloud radiative properties such as cloud albedo, bidirectional reflectance, and emissivity. Simulation studies will examine the sampling requirements and cloud measurement capabilities of current and future satellite measurement systems. Use of passive and active microwave observations are of special interest in addressing the problems associated with multilayered cloud systems. Studies are also encouraged that analyze cloud data as large ensembles of cloud systems or "cloud objects": a Lagrangian analog to the more traditional Eulerian monthly averaged gridded climate data. Cloud studies of this sort include attempts to unscramble changes in cloud dynamics from aerosol effects on clouds, i.e. the aerosol indirect effect. Opportunities also exist for the advancement of radiative transfer model algorithms to improve both the physical representation and speed of computations. These algorithms are being used to investigate the radiative impacts of observed changes to trace gas abundances, as well as to changes in the cloud and aerosol properties (e.g., amount and distribution).

RO #18093

Advisor: James Crawford, james.h.crawford@nasa.gov 757-864-7231

"Tropospheric Chemistry"

This opportunity focuses on research to improve understanding of tropospheric chemical cycles, both at a fundamental level and with respect to predicting future changes. High priority is placed on understanding the transport and photochemical evolution of regional pollution as it is incorporated into the global atmosphere. NASA observations relevant to this research include both airborne and satellite observations. NASA possesses an extensive database of in-situ observations from both past and ongoing aircraft campaigns. These campaigns have provided some of the most complete characterizations of tropospheric composition ever obtained. Satellite observations from the Terra, Aqua, and Aura satellites include observations of carbon monoxide, ozone, and other important tropospheric trace constituents. Modeling tools available to evaluate these data sets includes both simple box models and trajectory models, as well as regional and global chemical models. Data analysis and modeling aimed an integrating aircraft and satellite observations are critical to both validation and interpretation of satellite observations. Research is not solely limited to NASA observations, as field campaigns routinely involve cooperation between NASA, other domestic agencies, and foreign partners.

RO #18101

Advisor: Craig Streett, craig.l.streett@nasa.gov 757-864-2230

"Transition Modeling"

Current models for the transitional region (i.e., the intermediate region between laminar flow and fully turbulent flow) are inadequate. Since this is an especially important technological issue for advanced, high-speed aerospace vehicles and for computational fluid dynamics of high-lift systems, we must do research on nonlinear transition physics, and develop and calibrate phenomenological transition models. Research of particular interest includes subgrid-scale models for transitional flows, second-order closures for transitional flow, performance and/or analyses of direct and large-eddy simulations of transition, and inclusion of near-field turbulent waves. Incorporation of compressibility effects is desirable for all of these areas, but is not essential. We are also interested in the use of transition modeling and prediction in developing and analyzing methodologies for controlling nonlinear transition physics.

RO #18103

Advisor: James Crawford, james.h.crawford@nasa.gov 757-864-7231

"Tropospheric Chemistry"

This opportunity focuses on research to improve understanding of tropospheric chemical cycles, both at a fundamental level and with respect to predicting future changes. High priority is placed on understanding the transport and photochemical evolution of regional pollution as it is incorporated into the global atmosphere. NASA observations relevant to this research include both airborne and satellite observations. NASA possesses an extensive database of in-situ observations from both past and ongoing aircraft campaigns. These campaigns have provided some of the most complete characterizations of tropospheric composition ever obtained. Satellite observations from the Terra, Aqua, and Aura satellites include observations of carbon monoxide, ozone, and other important tropospheric trace constituents. Modeling tools available to evaluate these data sets includes simple box models and trajectory models, as well as regional and global chemical models. Data analysis and modeling aimed an integrating aircraft and satellite observations are critical to both validation and interpretation of satellite observations. Research is not solely limited to NASA observations, as field campaigns routinely involve cooperation between NASA, other domestic agencies, and foreign partners.

RO #18104

Advisor: Jennifer Olson, jennifer.r.olson@nasa.gov 757-864-5327

"Tropospheric Studies"

In recent years, a major focus in tropospheric chemistry has been to advance the understanding of processes that impact tropospheric chemistry from local to global scales. Aircraft campaigns such as NASA's Global Tropospheric Experiment missions have collected a broad suite of atmospheric physical and chemical data to characterize regional distributions and chemical interactions of trace species. Assessments of these regional chemical environments by techniques such as diel steady state boxmodel analyses can produce estimates for budget parameters such as regional photochemical tendencies for ozone. One of the difficulties facing tropospheric chemists is the interpretation of these in-situ data on local to regional scales in the context of global satellite data. To address this issue, we are conducting research using a suite of photochemical and transport models on scales from diel steady state point models and lagrangian trajectory boxmodels to regional and global chemical/transport models.

RO #18105

Advisor: Patrick Johnston, patrick.h.johnston@nasa.gov 757-864-4966

"Ultrasonic Array Concepts for Nondestructive Evaluation of Advanced Materials"

In conventional applications of ultrasonic nondestructive evaluation, a one-dimensional drive signal is applied to a two-dimensional transducer, which radiates sound into a three-dimensional space, where it interacts with a three-dimensional volume of material. The resulting multidimensional ultrasonic field is integrated over a two-dimensional receiving aperture to generate a one-dimensional output signal, which is analyzed and interpreted with regard to the condition of the material. This detection process drastically affects the amount and character of information contained in the output signal. Array transducer concepts provide a mechanism for controlling spacial and temporal relationships normally fixed by geometry. Segmented transmit and receive apertures allow tailoring of transmitted fields and receiving directivities, and enable the use of nonlinear spacial processing. Research includes basic studies of field generation by arrays and array design, and applied studies using array concepts to investigate wave propagation in materials and ultrasonic interactions with advanced materials and their defects.

Opportunity is restricted to U.S. citizens only.

RO #18217

Advisors: Jennifer Olson, jennifer.r.olson@nasa.gov 757-864-5327
James Crawford, james.h.crawford@nasa.gov 757-864-7231
Margaret Pippen, m.pippin@nasa.gov 757-8649366
Gao Chen, gao.chen@nasa.gov 757-864-2290

"Tropospheric Chemical Studies"

Many observed changes in global atmospheric composition and associated chemistry can be linked to anthropogenic activity. This opportunity solicits research to improve understanding of tropospheric chemical cycles, both at a fundamental level and with respect to predicting future changes. High priority is placed on understanding the transport and photochemical evolution of pollution as it moves from local to regional scales and is ultimately incorporated into the global atmosphere. NASA observations relevant to this pursuit include ground-based, airborne, and satellite observations. NASA possesses an extensive database of in situ observations from both past and ongoing aircraft campaigns. These campaigns have provided some of the most complete characterizations of tropospheric composition ever obtained. Satellite observations from the Terra, Aqua, and Aura satellites include observations of carbon monoxide, ozone, NO2, and other important tropospheric trace constituents. These satellite measurements can provide long-term global coverage data. Modeling tools available to evaluate these data sets include both simple box models as well as regional and global chemical models. Box models are ideal for diagnosing basic chemical understanding through the prediction of observable quantities (e.g., OH, HO2, CH2O, H2O2, HO2NO2, etc.). Box models are also useful for making observation-based estimates of photochemical impacts such as ozone production rates, reactive nitrogen budgets, and photochemical lifetimes both at a point as well as along a trajectory. These results are complementary to regional and global models which address the combined effect of emissions, chemistry, and transport processes on the spatial and temporal distributions of trace constituents, but are limited in their ability to reproduce the true atmospheric state. We encourage investigations incorporating both data analysis and modeling aimed at integrating in-situ and satellite observations. Such activities are critical to both validation of satellite observations as well as the interpretation of satellite observations and their relevance to understanding tropospheric chemical processes and future changes in atmospheric composition.

RO #18222

Advisor: Peter Parker, peter.a.parker@nasa.gov 757-864-4709

"Statistical Engineering"

Opportunities are available for research and development in statistical engineering in the area of Exploratory Data Analysis, Design of Experiments, Response Surface Methodology, Regression Analysis, Statistical Quality Control and Process Monitoring, and Analysis of Variance (ANOVA). Aerospace applications include the investigation of fundamental physics phenomena and the development, test, and evaluation of aerospace vehicle systems. Experimental systems include both physical experiments and computational simulations, and the integration of these systems in complementary roles is emphasized. Potential research areas are (1) design and analysis methods for physical and computational experiments to characterize high-dimensional complex response surfaces based on classical linear models, generalized linear models, non-linear models, semi-parametric regression, and nonparametric regression, (2) design and analysis methods for response surfaces designs with multi-dimensional profile responses, (3) design and analysis of experiments for restricted randomization, including mixed modeling, and (4) regression analysis and uncertainty quantification for observational data. While the research areas have broad definitions, they share the common focus of providing efficient, defendable, and insightful statistical methods to support aerospace research and development.

RO #18269

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Stephen W. Smith, s.w.smith@larc.nasa.gov 757-864-8946

"Computational and Experimental Damage Science of Metallic Materials"

Computational and experimental damage science of metallic materials is pursued in support of NASA Aeronautics Program research activities to (1) understand fundamental damage processes at the mesoscale including fracture and plastic flow; and (2) develop metallic materials with novel microstructures and enhanced functionalities. Analyses across a range of length scales from nanometers to millimeters are of interest and include molecular dynamics, crystal plasticity, strain gradient plasticity and finite element-based micromechanics analysis. Due to the broad range of length scales involved, the development of approaches for efficient multiscale modeling is of particular interest. Experimental validation of analytical damage based models and material characterization of materials for inclusion in the atomistic based models is necessary. Materials synthesis of novel materials and functional alloys is required. Any qualified candidate shall possess skills to be part of a team contributing to improved analytical capabilities, materials testing and analysis or materials synthesis.

RO #18271

Advisor: Thiagarajan Krishnamurthy, t.krishnamurthy@nasa.gov 757-864-3207

"Integrated Diagnostics and Prognostics for Airframe Structure Health Management"

The integration of diagnostics (assessing the current state of damage) and prognostics (predicting future states of damage) is critical to the development of a working Integrated Vehicle Health Management system. Here, diagnostic and prognostic elements are integrated with uncertainty analysis to produce continuously updated estimates of structural integrity and remaining structural life based on the loading history, current structural state and environment. Diagnosis models under development at NASA and elsewhere may be used to determine and interpret the current state of the structure based on sensor data. Similarly, existing predictive methodologies may be leveraged as the baseline for the integrated prognosis system. Any qualified candidate shall possess skills to be part of a team contributing to development of techniques for integration of diagnostic and prognostic estimates of structural health and/or development of techniques for incorporating uncertainty analysis within this predictive methodology.

Opportunity is restricted to U.S. citizens only.

RO #18284

Advisors: Chris Hostetler, chris.a.hostetler@nasa.gov 757-864-3120
Jonathan W. Hair, johnathan.w.hair@nasa.gov 757-864-1406
Richard A. Ferrare, richard.a.ferrare@nasa.gov 757-864-9943

"Airborne High Spectral Resolution LIDAR"

NASA Langley Research Center (LaRC) recently developed an airborne High Spectral Resolution Lidar (HSRL) to measure aerosol and cloud distributions and optical properties. The HSRL technique takes advantage of the spectral distribution of the lidar return signal to discriminate aerosol and molecular signals to independently retrieve aerosol extinction and backscatter. The current LaRC airborne HSRL measures aerosol backscatter and depolarization at 532 and 1064 nm and aerosol extinction at 532 nm. The HSRL along with the Langley Oxygen A-band Spectrometer (LAABS) and a newly developed Hyperspectral Polarimeter (HySPAR) have recently been successfully deployed on the MILAGRO and 2006 TexAQS/GoMACCS field campaigns as well as a series of CALIPSO validation flights. Flights from these field campaigns were coordinated with overpasses of A-Train and Terra satellite remote sensing instruments (CALIOP, MODIS, MISR, etc.) and other aircraft deploying in situ and remote sensing instruments that measured aerosol optical and/or microphysical properties. The data sets acquired offer extensive and unique opportunities to study the distribution of aerosol and explore combined active-passive retrievals of aerosol microphysical properties and techniques for inferring aerosol composition/type. These retrievals would address both current and future space-based (e.g. CALIPSO, MODIS, MISR, GLORY) and airborne (HSRL, HySPAR, LAABS, RSP) measurements. In addition, LaRC is currently developing an advanced HSRL instrument which will include additional wavelengths in the UV to provide measurements of ozone via the DIAL technique and aerosol extinction and backscatter at 355 nm. The addition of the UV extinction and backscatter measurements to the measurements at 532 and 1064 nm will provide data to explore advanced retrievals of aerosol microphysical parameters. An opportunity exists for qualified candidates to participate in the airborne HSRL activities that include evaluating instrument performance and data quality, developing new algorithms or approaches to derive aerosol optical and microphysical properties, and contributing to the scientific analyses of current data sets that integrate measurements from other participating aircraft and satellite platforms. It is also anticipated that the candidate would deploy with the LaRC team on future field campaigns to participate in real-time and post flight analyses of the airborne HSRL data and form collaborations with investigators from other platforms and the modeling community on the use and interpretation of the airborne HSRL data. Candidates with prior experience in lidar data analysis and system design/operation are preferred.

NASA HQ Sponsors: Hal Maring; Bruce Doddridge

RO #18285

Advisors: Marty Mlynczak, m.g.mlynczak@nasa.gov 757-864-5695
M. J. Gazarik, michael.j.gazarik@nasa.gov 757-864-1243
David P. Kratz, david.p.kratz@nasa.gov, 757-864-5669

"Whole Atmosphere Climate Science"

This is an opportunity to conduct multidisciplinary research into the climate and energy balance of the atmosphere from Earth's surface to the edge of space. Current topics under investigation include solar-terrestrial coupling in the thermosphere, mesosphere, and stratosphere; long-term climate change in the stratosphere; and the water vapor greenhouse effect, water vapor feedback, and radiative forcing of climate by cirrus in the upper troposphere. A variety of datasets and theoretical tools are available including data from NASA satellites including TIMED, Aura, Aqua, and SORCE. Field work with new instruments (FIRST, Far-Infrared Spectroscopy of the Troposphere) and related data analysis is also offered. Long-term focus in on determining the magnitude of climate change throughout the whole atmosphere, with a particular focus on the climate of the troposphere through the NASA CLARREO satellite mission currently in pre-formulation.

RO #18286

Advisor: Duncan Fairlie, t.d.fairlie@nasa.gov 757-864-5818

"Global Atmospheric Modeling and Data Analysis"

This is an opportunity to conduct fundamental or applied research in the Chemistry and Dynamics Branch of the Science Directorate at NASA Langley Research Center. Our goal is to understand the physical and chemical processes that control the chemical composition of the Earth's atmosphere, and its impact on air quality and climate. We are particularly interested in the intercontinental transport and climate impacts of atmospheric particles (aerosols) from both natural (e.g. desert dust, volcanic eruption) and manmade sources. Our group uses observations made from satellites, aircraft and ground-based systems, and uses state-of-the-art atmospheric models (e.g. GEOS-5) to provide understanding of the role of meteorology, transport, physics, and chemistry in controlling atmospheric composition. NASA Langley is the home of satellite observations for more than 25 years with the SAGE and CALIPSO missions, providing an unprecedented 3-D view of aerosols in the atmosphere. We are also the home of multiple in-situ and remote sensing instruments, e.g. HSRL, deployed on airborne field campaigns, designed to measure trace gases and aerosols in the atmosphere. This multi-discipline environment makes the Science Directorate a unique and stimulating place to work.

RO #18460

Advisor: Xu Liu xu.liu-1@nasa.gov 757-864-1398

"Radiative Transfer Modeling, Retrieval Algorithm Development for Hyperspectral Remote Sensors"

The current and next generation satellite infrared sensors such as AIRS, IASI, CrIS, SCIAMACHY, OMI, and CLARREO all have one thing in common: large number of spectral channels. In order to fully utilize the information content of these sensors, a large number of Radiative Transfer (RT) calculations through the inhomogeneous atmosphere are needed. Usually, only subsets of channels are used to perform physical inversions for atmospheric profiles due to computational limitations. Our goal is to use all available spectral channels in analyzing these satellite data.
At NASA Langley Research Center, we are exploring different ways to accelerate radiative transfer calculations and inversion process. One way is to use Principal Component Analysis (PCA) to compress the information content of these hyper spectral data and then perform radiative transfer calculations. This method has been successfully used to analysis data from numerous satellite and airborne remote sensing data. Other research area include fast cloud modeling, inversion algorithm for atmospheric temperature, cloud, and trace gas retrievals, climate OSSE and fingerprinting, satellite data assimilation, end-to-end instrument performance simulations. We are looking for candidates who are interested in radiative transfer modeling, inversion algorithm development, and satellite data analysis.

RO #18461

Advisor: Glenn Diskin, glenn.s.diskin@nasa.gov 57-864-6268

"In-Situ And Remote Sensing Of Greenhouse And Other Trace Gases In The Atmosphere"

Work in our group involves the design, development, and deployment of in situ and remote sensors to measure concentrations of greenhouse and other gas phase species in the atmosphere. These instruments are typically operated by personnel from our group aboard large NASA-owned aircraft such as the DC-8 and P-3, as well as other smaller manned and unmanned aircraft. We strive to make accurate, highly precise, time-resolved measurements of interest to and in support of the atmospheric chemistry, transport, and dynamics communities.
We currently operate two primary in situ instruments: DACOM (which measures carbon monoxide, CO, methane, CH_4, and nitrous oxide, N_2O) and DLH (which measures water vapor, $H_2O(v)$). These instruments use tunable diode lasers in the infrared spectral region to measure the absorbance of light by these species. The DACOM instrument in particular presents opportunities to incorporate newer laser technology, including quantum cascade (QC) and difference frequency (DFG) laser sources now available in our laboratory.
We also are in the process of developing passive remote sensors for the measurement of CO and CH_4 columns from aircraft or satellite platforms.
We are seeking applicants with an interest in hands-on instrument development, a passion for detail, and a desire to push the state of the art. A willingness to travel to exotic and not so exotic locations is a must.

RO #18462

Advisor: Mary Ann h. Smith, mary.ann.h.smith@nasa.gov 757-864-2701

"High Resolution Spectroscopy of Atmospheric Molecules"

Detailed knowledge of the molecular spectra of water vapor, carbon dioxide, ozone and other atmospheric species is necessary for interpretation of remote sensing measurements and for accurate calculation of atmospheric heating and cooling rates in climate models. The molecular spectroscopy research effort at NASA Langley is focused on improving knowledge of the infrared spectroscopic line parameters (positions, intensities, assignments, broadening and pressure induced shift coefficients, and line mixing parameters) of key atmospheric constituents through laboratory measurements. High-resolution infrared absorption spectra are recorded using off-site Fourier transform spectrometer (FTS) facilities such as the Bruker IFS 125 HR at Jet Propulsion Laboratory or the Bruker IFS 120 HR at Pacific Northwest National Laboratory. A large data archive of spectra recorded with the McMath-Pierce FTS at Kitt Peak is also available for analysis. Spectra obtained from other types of spectrometers such as tunable lasers or cavity-ringdown systems can be combined with FTS spectra in the analyses. A powerful multispectrum fitting technique to obtain the desired spectroscopic parameters. Theoretical interpretation of the results and validation with atmospheric and other laboratory data is done in collaboration with investigators at NASA Langley and several other institutions. These studies have contributed to a number of major upgrades of the HITRAN (High-resolution Transmission) and other spectroscopic parameters databases with world-wide distribution.

RO #18594

Advisor: Narasimha Prasad, narasimha.s.prasad@nasa.gov 757-864-9403

"Development of Software Analysis Tools Based on Spectrocopic Data Bases such as HITRAN for Atmospheric Trace Gas Detection Lidars from Space Based Platforms"

There is a need to develop effective software analysis tools based on HITRAN and other spectroscopic databases to predict LIDAR performance for atmospheric trace gas detection from space based platforms. The variation of line parameters with pressure, temperature and line shape functions have to be accurately known for calculation of mixing ratios of a given trace gas species. The ongoing ASCENDS program at NASA Langley will benefit from these tools for accurate prediction of CO2 and oxygen mixing ratios. Practical LIDAR instrumentation models can be developed by incorporating these tools to aid in refining LIDAR system parameters for achieving less than 0.3% accuracies in CO2 mixing ratio under various atmospheric conditions. Opportunity is restricted to U.S. citizens only.

RO #18625

Advisors: Christopher Rumsey, c.l.rumsey@nasa.gov 757-864-2165
Stephen Woodruff, stephen.l.woodruff@nasa.gov 757-864-6047

"Turbulence Modeling for Aerodynamic Applications"

The goal of this research is to develop improved predictive capability for turbulent separated flow. Areas of interest include large eddy simulation (LES) including improved sub-grid scale models, near wall treatment and numerical methods; hybrid RANS-LES methods including improved bridging methodologies; and new and improved turbulence models for Reynolds-averaged Navier-Stokes (RANS) codes. A significant focus will be on the use of LES computations to help guide the development of improved RANS models, including Reynolds Stress (second-moment) models. Some of the applications of interest include corner separated flows, smooth-body adverse-pressure gradient separated flows, and active flow control (wall jet blowing, suction, and oscillatory control applications).

If the research plan proposed by the applicant requires NASA provided resources in the form of computer software, source code, and/or supercomputing hours, the pertinent details should be included in the application.

RO #18749

Advisor: Patrick Taylor, patrick.c.taylor@nasa.gov 757-864-7581

"Global Climate Model Diagnostics and Evaluation: At the Intersection of Models and Satellite Data"

Understanding the complex interactions that comprise Earth's climate system is an urgent problem whose answer has significant implications on human life, economics, and geo-politics. The most comprehensive tool available to study climate system evolution is the general circulation model (GCM), which is an amalgamation of physical processes involving the atmosphere, ocean, cryosphere, biosphere, and their interactions that produce Earth's climate. Our understanding of these processes is incomplete; therefore, GCMs are imperfect making the evaluation, diagnosis, and attribution of GCM deficiencies is an important area of research. This opportunity is motivated by the need to evaluate, diagnose, and understand critical physical processes using models and observations to improve GCMs. This goal of this group is to evaluate, diagnose, and attribute model errors to physical processes through innovative approaches using NASA satellite data (e.g., CERES, CALIPSO, CloudSAT, and MODIS). The research being conducted evaluates GCMs on timescales from the diurnal cycle to interannual variability and on spatial scales from local to global. Specific focuses within this opportunity include interactions between polar clouds, sea ice, and poleward heat transport, the representation of extratropical cyclones and mid-latitude cloud feedbacks, and evaluating GCM diurnal cycle representation and the "knock-on" effects to the climate state and its evolution.

RO #18760

Advisors: Jirong Yu, j.yu@nasa.gov 757-864-1766
Upendra Singh, upendra.n.singh@nasa.gov 757-864-1570
Mulugeta Petros, mulugeta.petros-1@nasa.gov 757-864-8583

"Mid-infrared Laser and Lidar Development"

A research group in the Laser Remote Sensing Branch in the Engineering Directorate at NASA's Langley Research Center focuses on laser and lidar developments that is relevant to NASA's earth science priorities. The research group develops solid state laser technology that is more efficient, compact and powerful to provide capabilities meeting the laser transmitter requirements called out in the missions by the recent Earth Science Decadal Survey. In particular, the group develops the state-of-the –art mid-IR lasers at 2-micron wavelength for global wind and CO2 measurements. In addition, the group also works on precisely laser wavelength tuning, wavelength locking, wavelength switching, and laser wavelength conversion by non-linear optics techniques various remote sensing instrument needs. The research group also develops lidar system for atmospheric wind and trace gas measurements in the ground and airborne platforms, that include design of telescope and aft optics, precisely beam controlling, detector characterization, signal processing algorism development. The field deployment of these lidars supports Earth science missions.

RO #18763

Advisor: Narasimha Prasad, narasimha.s.prasad@nasa.gov 757-864-9403

"Doublet Pulse Coherent Ladar Based Space Situational Awareness and Science Measurement"

Recently, NASA Langley has established a long range, pulse doublet Coherent ladar for space situational awareness and science applications. Mobility is one of its attractive features. Current research using this ladar system includes tracking resident space objects (RSOs) for conjunction management, micro-motion of RSOs, and imagery in low earth orbit (LEO) and beyond. Fundamental and applied research is being planned to develop and improve the coherent ladar performance by incorporating an ultrastable seed laser (1 Hz linewidth absolute frequency control ultrastable reference laser) for injection seeding purposes. This opportunity solicits research to utilize pulse doublet coherent ladar for ground based gravitational field measurements, absolute time interferometry, precision navigation and timing studies, detection of space-time distortions, and general relativity. The post-doctoral candidate must meet the following requirements: PhD degree in electrical engineering or physics, knowledge and experience in Lasers, Ladars, and programming in Matlab and/or C. Investigations could include theoretical study, performance modeling, ladar transceiver architecture enhancement and experimental measurements.

Opportunity is restricted to U.S. citizens only.

RO #18806

Advisors: Rosemary Baize, rosemary.r.baize@nasa.gov 757-864-7157
Seiji Kato, seiji.kato@nasa.gov 757-864-7062
Marty Mlynczak, m.g.mlynczak@nasa.gov 757-864-5695
Bruce Wielicki, b.a.wielick@nasa.gov 757-864-5683

"Measurement of Climate Change from Space"

Research in the interpretation of highly accurate Earth radiances for the purpose of diagnosing the magnitude and pace of climate change. The NASA Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission, presently in pre-formulation, will make observations of reflectance spectra by the Earth at ultraviolet through near-infrared wavelengths (0.32 to 2.3 μm) and emitted radiance spectra by the Earth from far-infrared to mid-infrared wavelengths (5 to 50 μm). The radiometric accuracy of these data will be unprecedented, and will be traceable, on-orbit, to international metrological standards. The position involves calculation and simulation of CLARREO measurements, developing advanced techniques for interpreting the time rate of change of these measurements ("fingerprinting" methods), and for including realistic measurement uncertainty in the analyses. The position provides direct involvement in CLARREO instrument development and in specification of instrument measurement requirements. Techniques for exploiting the CLARREO data on all timescales (annual to decadal) are to be developed.

RO #18823

Advisor: Meelan Choudhari, meelan.m.choudhari@nasa.gov 757-864-5360

"Transition Modeling for Aerodynamic Applications"

Transition modeling has been projected to remain a pacing item for the use of Computational Fluid Dynamics (CFD) in the aerospace design process. In particular, improved integration of transition modeling within the CFD codes would lead to enhanced prediction accuracy for the aerodynamic metrics and a significantly reduced cost for simulating turbulent flows using large-eddy simulation (LES). This research will focus on one or more of the following aspects of transition modeling: integration of variable fidelity predictive models for laminar-turbulent transition into CFD predictions based on Reynolds Averaged Navier-Stokes (RANS), LES, or hybrid RANS/LES approaches and the development and application of high fidelity analysis tools for various stages of laminar-turbulent transition. If the research plan proposed by the applicant requires NASA provided resources in the form of computer software, source code, and/or supercomputing hours, the pertinent details should be included in the application.

RO #18852

Advisor: Ali Omar, Ali.H.Omar@nasa.gov, 757-864-5128

"Enhanced Classification Schemes Using Lidar Measurements for the Development of a Global Climatology of Aerosol Types from the 8-year CALIPSO Record"

This position seeks a post-doctoral fellow to conduct research and studies of the processes affecting the composition and structure of the Earth's atmosphere and Earth's climate system. In particular, the selected candidate is expected to develop methods that will improve the classification algorithms of aerosols (see the current methods in *Omar et al. 2009*) using measurements of the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission and where necessary measurements from other missions in the A-Train constellation. The post-doctoral fellow will develop objective classification methods to improve CALIPSO's aerosol typing and provide the community with an improved basis for estimated global aerosol burdens and thereby provide observation-based estimates of speciated direct aerosol radiative forcing. The candidate will also develop theoretical basis for a key parameter, the extinction-to-backscatter ratio (commonly referred to as the 'lidar ratio'), for the classes of aerosols determined by the classification algorithms. Such studies will involve the use of constrained retrieval methods wherever the aerosol optical depths (AODs) are well characterized. At the end of the program, the post-doctoral fellow is expected to have developed and implemented an innovative, robust aerosol classification and lidar ratio selection algorithm, and designed validation, quality assessment, and uncertainty methodologies for the aerosol classification schemes that may be portable to other measurements, e.g., the Cloud Aerosol Transport System (CATS) lidar on the ISS or the upcoming EarthCare lidar measurements.

Requirements: A Ph. D. in a Geoscience discipline, Engineering , Physics or Chemistry, and familiarity with CALIPSO, and MODIS measurements and data structures.

RO #18864

Advisor: Danette Allen, Danette.Allen@nasa.gov ,757-864-7364

"Neuromorphic Computing Systems for UAV Collision Avoidance"

This postdoc position is intended for the design, development, and implementation of brain inspired visual algorithms for the purposes of Unmanned Aerial Systems (UAS) Sense And Avoid (SAA) technology. One of the major obstacles to the deployment of effective SAA systems is the absence of a fast, precise methodology to spot obstacles in the airspace and on the ground. Traditional computer vision approaches to SAA rely heavily on trained object detectors (e.g. Haar-cascades) in order to detect objects of interest. These detectors are usually represented as cascades of linear classifiers with limited recognition capabilities. In contrast, biological vision systems, which exemplify a "system" that has evolved to quickly and successfully avoid collisions, use hierarchical structure of non-linearly combined features to represent the world.

This work will focus on the development of neurologically-inspired algorithms that can build object models via a hierarchical feature framework and that is capable of detecting objects in real time with low false alarm on use of a physical UAS platform. As such the work will be geared specifically toward object classes present during UAS takeoff/landing but will also be applicable to en-route flight.

Ideal candidates should have previous research experience working in visual computational neuroscience, should be knowledgeable in developing computer vision algorithms geared towards UAS collision avoidance, and should be fluent in one or more of the following programming languages: Matlab, C++, JAVA, Python. Familiarity with UAS (quadcopters in particular) would be a plus.

RESEARCH OPPORTUNITY RESTRICTED TO US CITIZENS ONLY.

RO #18855
Advisor: Craig Brice, Craig.A.Brice@nasa.gov , 757-864-7792

"Metallic Material and Manufacturing Process Development"

This research area focuses on the development of innovative processing methods for complex metallic structures along with novel alloy materials for use in both conventional and new processes. The primary interest is in additive manufacturing / 3D printing techniques along with light alloy structural material systems (e.g. aluminum, titanium). Of particular interest are metal matrix composite structures for weight critical, high performance applications. Also of interest are next generation metallic materials systems such as bulk metallic glasses. This research will involve process development studies, analytical characterization of materials, and testing of structural concepts.

RO #18857
Advisor: Mark Carpenter, Mark.H.Carpenter@nasa.gov , 757-864-2318

"Adjoint Based Dynamic Grid Adaptation"

The goal of the research is to develop new, and improve existing numerical algorithms currently used in Large Eddy Simulations (LES) and hybrid Reynolds-averaged Navier-Stokes (RANS-LES) simulations of complex separated flows. The primary focus will be on two problematic issues: 1) developing efficient dynamic grid adaptation strategies for unsteady separated flow simulations, 2) developing accurate and stable adjoint techniques for unsteady flows. All algorithmic development efforts will be performed in close collaboration with turbulence experts. Promising algorithms will be implemented as much as possible into existing LES and RANS-LES software, whereby simulations of complex separated flows will be used to establish their efficacy. The post-doctoral candidates should meet all or most of the following requirements to be considered for the position; 1) PhD degree in applied mathematics, computer science, computational engineering, or equivalent; 2) knowledge and experience in large-scale code development using Fortran-95 and/or C++, and massively parallel simulations of complex flow phenomena; 3) knowledge of grid adaptation and adjoint techniques; 4) knowledge of linear and nonlinear stability theory; 5) knowledge of large equation solvers (linear and nonlinear). U.S. Citizens or permanent residents will conduct research as part of in-house development team. Foreign nationals will focus on open-source software packages to perform their research.

RO #18881

Advisor: Catherine McGinley, Catherine.B.McGinley@nasa.gov, 757-865-5557

"Turbulence Modeling Validation Experiments"

The goal of this research is to design and conduct a validation experiment to improve the predictive capability for turbulent separated flows. Modern day turbulence models for Reynolds-averaged Navier-Stokes (RANS) are incapable of consistently predicting turbulent separated flows. In particular, for smooth body (adverse-pressure-gradient-induced) separation, RANS models tend to severely under-predict the magnitude of the turbulent shear stress levels in the shear layers near the start of "large" separation bubbles. As a result, bubble size is incorrectly predicted. High-quality experiments designed specifically for CFD validation are needed to help turbulence modelers diagnose, correct, and validate models used for both RANS and for hybrid (scale-resolving) methods. A significant focus will be on high quality validation data sets and the use of non intrusive diagnostics.

Citizenship Requirements:

U.S. Citizens Accepted, Lawful Permanent Residents Accepted

RO #18892

Advisor: Brian Walsh, Brian.M.Walsh@nasa.gov , 757-864-7112

"Solid State Laser Materials Development"

The Laser Materials Development research group in the Laser Remote Sensing Branch (LRSB), Engineering Directorate (ED) at NASA Langley Research Center conducts research focused on laser materials, spectroscopy and laser engineering in areas relevant to NASA's earth science mission. The work encompasses theoretical models, fundamental science research, and laser engineering of devices, using a combination of modeling, experiment and laser design. This is an ongoing state-of-the-art endeavor to research and design new materials that meet new objectives in line with NASA's interests. The three tiers of work can be summarized as follows:

1.) Modeling: Ab initio quantum mechanical design and evaluation of laser materials (e.g., energy levels, energy transfer parameters, and transition probabilities) in addition to simulation of solid state oscillators and amplifiers to predict, evaluate and improve laser performance.

2.) Spectroscopy: Development of solid state laser materials, specialized in spectroscopy of rare earth ions in solids (absorption, emission, quantum efficiency, energy transfer, energy levels, Judd-Ofelt theory).

3.) Engineering: Solid state lasers (Resonator design, flashlamp pumping, diode pumping, Q-switching, non-linear frequency conversion).

Some examples of work include laser materials such as Tm:Ho:YLF and Tm:Ho:LuLF for 2.0-µm applications, Er:Tm:Ho:YAG and Er:Tm:Ho:LuAG for dual wavelength medical applications at 2.1 µm and 2.9-µm, Nd-doped compositionally tuned mixed garnets for laser applications around 0.94 µm, Tm-doped glasses for fiber laser applications, multi-wavelength Nd:YAG for frequency mixing and second harmonic generation for UV applications, Er:YAG and LuAG lasers at 1.6 µm and 2.7 to 2.9 µm for a variety of applications, quantum dot laser materials for thermometry, and mid infrared (MIR) laser materials in the 3 – 10 µm region. MIR lasers using low phonon materials presents certain challenges, but the potential of a variety of lasers beyond 3 µm is an appealing prospect being pursued.