Opportunity Title: Radiative Transfer Modeling, Retrieval Algorithm Development for Hyperspectral Remote Sensers
Opportunity Reference Code: 0010-NPP-NOV23-LRC-EarthSci

Organization National Aeronautics and Space Administration (NASA)

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Application Deadline 11/1/2023 6:00:59 PM Eastern Time Zone

Description

Current and future hyperspectral / ultraspectral satellite sensors such as Atmospheric Infrared Sounder (AIRS), Infrared Atmospheric Sounding Interferometer (IASI), Cross-track Infrared Sounder (CrIS), Ozone Monitor Instrument (OMI), CLARREO PathFinder (CPF), Tropospheric Emissions: Monitoring of Pollution (TEMPO), Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), and Surface Biology and Geology (SBG) provide a wealth of information on the Earth‘s atmospheric vertical and horizontal structures, cloud and surface properties. To fully exploit the vast amount of spectral information from these hyperspectral / ultraspectral instruments, fast and accurate radiative transfer models and efficient retrieval algorithms are needed.

At NASA Langley Research Center, we are developing novel radiative transfer models and associated retrieval algorithms, which compress thousands of the hyperspectral / ultraspectral channels into super-channels. These super-channels have one order of magnitude smaller dimension; yet contain all the information content of the original observations. For example, by using a Principal Component Analysis (PCA), we can compress 8461 IASI spectral channels into 100 super-channels. Our fast radiative transfer model is capable of calculating properties for both the super-channels and the original hyperspectral / ultraspectral channel radiances. The new radiative transfer model can also provide Jacobian matrices needed by a retrieval algorithm or a data assimilation system. The model is very accurate and flexible. It covers the spectral range from UV (300 nm) to far-IR (200 micrometer). Due to its high speed and compressed spectral information format, it has great advantages for super-fast one-dimensional physical retrievals or for Numerical Weather Prediction (NWP) large volume radiance data assimilation applications. Models of this kind have been successfully developed for IASI, AIRS, CrIS, and the National Airborne Sounder Testbed-Interferometer (NAST-I). We are also using this forward model to support NASA‘s future satellite sensors such as TEMPO, CPF, and SBG. We are looking for candidates who can further improve the forward model and retrieval algorithm and to analyze current and future hyperspectral / ultraspectral remote sensing data.
Another area of related research is to develop Machine Learning (ML) and Artificial Intelligence (AI) based radiative transfer models and retrieval algorithms. Traditional line-by-line radiative transfer models (LBLRTMs) are very time-consuming in generating large training data sets needed by ML and AI techniques. The PCA-based radiative transfer model developed at NASA Langley is ideal for this purpose since it is 3-4 orders of magnitude faster than LBLRTMs while its accuracy is comparable to that of the LBLRTMs.
Foreign Nationals Accepted. NASA Langley Research Center is a Federal facility. Access to the campus and IT tools is subject to security and visitation clearance. Foreign Nationals must contact the advisor prior to

starting the application to gain a mutual understanding that arrangements can be made to allow for efficient execution of the research project. Please note that applications by foreign nationals from Designated Countries will be subjected to added level of scrutiny. The ""Designated Country List"" can be found at the NASA Export Control website: https://oiir.hq.nasa.gov/nasaecp/.

References

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Liu, X., W. L. Smith, D. K. Zhou, and A. Larar, 2006: Principal component-based radiative transfer model for hyperspectral sensors: theoretical concept, Appl. Opt. 45, 201-209.

Location:
Langley Research Center
Hampton, Virginia

Field of Science: Earth Science

Advisors:
Xu Liu
Xu.Liu-1@nasa.gov
(757) 864-1398

Daniel Zhou
daniel.k.zhou@nasa.gov
757-864-5663

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Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Eligibility Requirements

- **Degree:** Doctoral Degree.