Paid Research Opportunity:

FDL-X: advanced applied AI research for NASA Heliophysics applications

Dear colleagues,

We are reaching out to **AI/ML specialists, heliophysics scientists and software engineers** who are interested in participating in interdisciplinary applied research this summer. The research is a paid engagement that runs during the academic holiday and publishable research is an explicit outcome.

FDL-X is a public private partnership with NASA, Trillium Technologies, Google Cloud, NVIDIA and leaders in commercial AI, with logistics support provided by the SETI Institute. This heliophysics pilot initiative is a derivative of the successful Frontier Development Lab (FDL) and will develop integrated applied AI research and technology for Heliophysics applications, building on a body of NASA data and AI pipelines generated during fdl.ai and hosted on SpaceML.org.

Research details
The FDL-X Integration challenge utilizes previous FDL projects as base components which will be matured individually and then integrated to solve one of the following challenges:

- **Thermospheric drag and atmospheric density projections:** Can we improve thermospheric drag models by integrating EUV irradiance models from FDL 2022: 4Pi Sun (4 EUV channels) and FDL 2018 (9 EUV channels) and combine with FDL 2019 to address missing channels? (Providing these models as input, along with SDO images to improve density projections.)

- **ARD EUV data.** Can we develop ARD products (Analysis ready data) of EUV irradiance for the community? This work builds on the work of SDOML and 4Pi (FDL 2022) which showed the ability to predict EUV irradiance at any vantage point around the Sun.

- **Hyperlocal geoeffectiveness:** Can we improve regional accuracy and forecast horizon of geoeffectiveness, improving on FDL's DAGGER pipeline?
    - Use the BSS methodology (Savani et al 2015, 2017) to derive CME speed, magnetic field and density (pressure) at L1 [2-3 days in advance]
    - L1 estimates are propagated to the magnetopause via NOAA tool (Cash et al. 2016) or similar method.
    - Magnetopause inputs are provided to a DAGGER derivative.
    - DAGGER outputs dB/dt forecast at regional level

In addition, we will explore broader questions of integration and process innovation:
- Can we integrate machine learning pipelines in a meaningful way?

Determination of one final challenge and the maturation process of the individual components will take place during the Challenge Decomposition Phase in early June with input from FDL-X faculty and researchers.

If any AI/ML specialists, heliophysics scientists and software engineers would like to apply they can apply here: https://frontierdevelopmentlab.org/apply (interviews are currently taking place, so please apply now).

If this sparks your interest, check our FDL.ai and read through additional key information included at the end of this email. Please share this opportunity with any of your colleagues and networks that might be interested. If you have any questions relating to the FDL-X program, please email Cesi at cesi@trillium.tech

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Anne Spalding
US Program Director
FDL USA

FURTHER INFORMATION

Key details:

- FDL-X is a program for PhD and PostDoc level researchers.
- FDL-X participants receive a **stipend** to support their participation
- FDL research often leads to published work (such as Science Advances and ApJ) and outputs are shared at AGU, NeurIPS, AAAI, NASA conferences - as well as partner events like Google Cloud's NEXT and Nvidia's GTC.
- Engage in cutting-edge research and deployment programs in AI, space and Heliophysics.
- Work closely with experts in the problem domain and experts in ML.
- Meet and work with experts from FDL partners (NASA, ESA, Google, Intel, Nvidia, Planet, Oxford University, SCAN, Berkeley Lab and many others).
- Here's an overview of FDL's Research Outputs from 2022: US - Europe.
- Researchers and faculty **contract with the SETI Institute** (FDL's logistics provider.)
- FDL's day-to-day operations are run by Trillium Technologies Inc, acting as FDL.

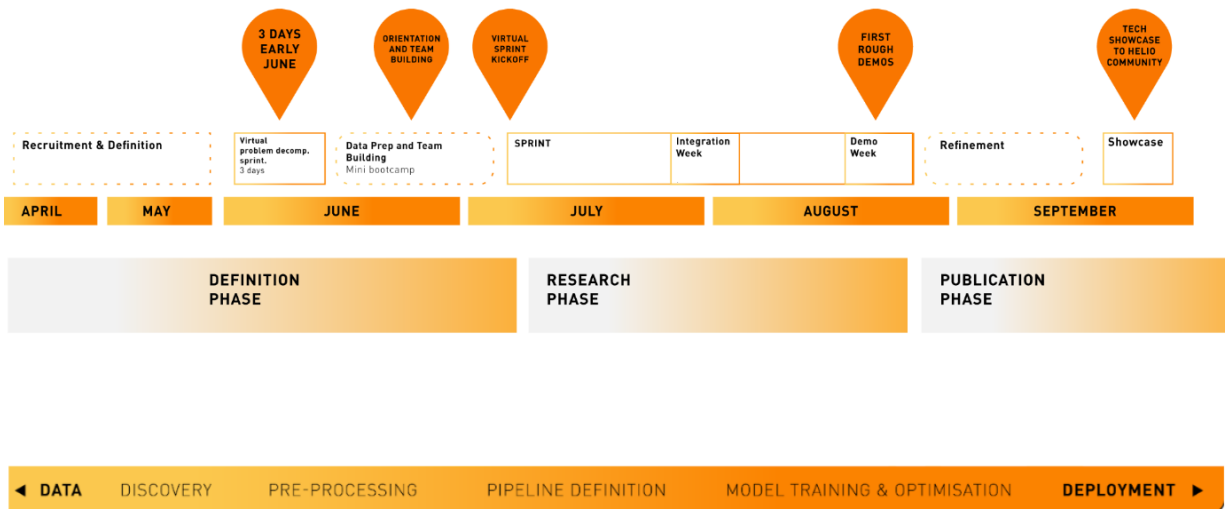
About FDL-X

FDL-X is an advanced applied AI research program for Heliophysics applications and ensures that AI outcomes are fine-tuned to tackle valid open science and engineering problems by building interdisciplinary approaches, between SMEs and ML and cloud-based engineering techniques.

The summer research integrated sprint will be based on previous FDL work (TRL 0-4) and technology and mature to (TRL 4-6) with an emphasis on tooling, modular development, reproducibility and testing the potential for integrated AI solutions, where proven AI pipelines inform each other to unlock brand new capabilities.

FDL-X Helio will be a 8-week full-time paid effort and the work will be carried out over three phases:

- Definition Phase: Challenge development, data prep and team building
- Research Phase: Sprint development and integration
- Publication Phase: Results refinement and publication



https://frontierdevelopmentlab.org/fdl-x-2023

There will be three FDL-X 2023 teams, each team will be made up of three participants with a mix of AI/ML specialists, heliophysics scientists and software engineers, and a faculty of experts will be assembled around each of the challenges. The teams will establish close links with scientists, researchers, industry organizations, partners, external experts and stakeholders.

Definition Phase
The program will start with a 'problem decomposition' virtual meeting that will be held in early June over three days. The overall goal is to examine how discrete AI pipelines and / or tools can work together in an integrated fashion to tackle more ambitious capability gaps to a clear and present problem, as well as scoping data sources (scale, availability and other factors), test algorithms and fine-tune the computing workbench, identify any other tools needed, and define success metrics prior to the highly focused 7-week sprint starting in early July.

Each challenge is broken into four components: Data collection (data engineering), Data pre-processing (data engineering), model train/evaluation (ML engineering), deploy, monitor and maintain (MLOPS engineering).

Research Phase
The 7-week integrated sprint will run between June - August 2023 and will support the natural progression of the results through development, pipeline, prototype, integration, calibration, improvement and Demo. Each week is carefully curated with a unique character, objective and energy, with an 'Integration Week' in week four, designed to be the moment that the independent research streams are brought together for the first time. During this time the research increases in technology readiness level, guided by formal and informal reviews at the end of each week and the teams will share their first rough demos mid-August.

Publication Phase
There will be a month of refinement to allow the teams to focus on polishing results by continuing to review and improve on their work - with specific focus on code clean-up for reproducibility. This is important for ensuring the validity and reliability of the research outcomes This will also give them the opportunity to create excellent documentation and revise their draft technical memos and publications with the latest findings, in preparation for the teams to share back coherent solutions with fully integrated components during a showcase with selected NASA stakeholders towards the end of September and a submission of their finalized technical memos for AGU and NeurIPS.

Please share with your colleagues and networks that might be interested in joining.

AI/ML specialists, heliophysics scientists and software engineers can apply here: https://frontierdevelopmentlab.org/apply (interviews currently taking place).

If you have any questions about FDL-X, please email cesi@trillium.tech

THANK YOU!