

Indian Science Technology and Engineering facilities Map (I-STEM)

Invites application for

the Partial Support to the Academic Users and Custodians for the fabrication & development of Indigenous Equipment/Products/Consumables (Format-2)

Proposal Format:

Support to Start-ups in the development and testing of an R&D product and its promotion for further improvement to achieve the better performance at par with the imported equipment (A unique program of I-STEM to achieve the goal “Aatm Nirbhar Bharat”).

(~~Equipment/tool/new software application for R&D/technical supplies like chemicals /ceramics /substrates or a value-added service~~)

Details of the Personal and financial Information

- a. Contact person name: Prajakta Sabnis
- b. Company name: Weedy Software Private Limited
- c. Department: Development
- d. Not Applicable(Name of the Lab)
- e. Mob. No.: +91 7829036111
- f. Email ID: prajakta.sabnis@oorja.energy

Project/Research topic Details:

- a. Project Title/Research Title: Development of a Computational Tool using Hybrid Simulation Approach
- b. Sub area: Design optimization and interface creation for electrochemical cell and pack design
- c. Area Description:

Accurate predictive analysis of new cell chemistries makes it imperative to combine state of the art numerical techniques with experimentation. Cutting edge numerical technology allows minimization of experimentation without compromising on the fidelity of predictive analysis.^{1,2,3} Additionally, batteries are optimized over a complex space of materials (electrodes, electrolytes, separators, binders etc.) and cell design parameters. The large design space coupled with wide variation in user behavior slow down the Li ion battery optimization process.⁴

Further prediction at the cell level alone is not sufficient since pack configuration significantly affects safety, performance and cell life. The same cells used in different pack configurations and having different cooling strategies have demonstrated to have given different power and life. Thus, it is important to perform predictive analysis of pack configurations as well.⁵

Battery life is also significantly impacted by vehicle usage. For example, if a battery is discharged up to, say, 5% SOC and then charged, it will degrade much faster than a battery that is discharged only up to 30% and then recharged.⁶ Batteries are also sensitive to overloading: a user discharging at higher C rates and exceeding the weight capacity of the vehicle can cause irrevocable damage to the battery.⁷

Predictive analysis which enables better module/ pack design and BMS design will significantly help mitigate these challenges.

The goal will be to

1. Explore how to minimize experimentation and combine it with sophisticated algorithms to maintain accuracy
2. Explore how resources can be pooled to create standardized data libraries which can be shared without compromising on accuracy
3. Create a minimum experiment set which can be quickly and reliably performed with little training and get maximum impact. Some of the testing includes, but is not limited to:
 - i. Cycle Life Testing
 - ii. Power Capacity Testing

References

- ¹Severson et al, Nature Energy, 4, 383, 2019
- ²P.W.C. Northrop et al. J Electrochem. Soc. 161 E3149 (2019)
- ³M-F. Ng et al. Nature Machine Intelligence, 2 161 (2020)
- ⁴C. R. Birklet et al. J Power Sources, 341, 373 (2017)
- ⁵A. Hosseinzadeh et al. App. Energy, 282, 115859 (2021)
- ⁶T. Guena and P LeBlanc, INTELEC 06, 1 (2006)
- ⁷P. Keil et al. J. Energy Storage, 6, 125 (2016)

d. Aim and Objectives

- i. Building HPPC Data base of cells by performing HPPC tests, useful for extracting reversible and irreversible losses in the cell
- ii. Building thermal properties database of cells, using charge-discharge experiments combined with oorja's thermal property estimation tool
- iii. Conducting Cycle-life tests, required for the capacity fade degradation
- iv. Run collaborative projects with Academic institutions to create a talent pool
 - e. Duration (MM/YYYY): 08/2022 – 08/2023
 - f. Total Cost (required): Rs. 5,00,000/-

g. Project Summary (800-1000 words):

We propose a unique, patentable hybrid approach for simulation, which uses a combination of physics and machine learning. Users can first use an approximate physics-based model to get the pre training data for the ML algorithm. The accuracy can then be obtained by using minimal experimental data and using it in the pre trained ML model. The need for only approximate physics-based models reduces the need for complexity, while the minimal data required for subsequent ML reduces the need for data while not compromising on accuracy. Our algorithms have been validated with experimental data and have proven to be within 90% accurate.

h. (Separate page may be attached to justify the requirements):

Built-in HPPC and Cell thermal properties database within the tool help users to get the accurate and faster predictions, without having to perform any additional experiments.

a. Technical Details (submit a full proposal describing the following) (see attachment)

- a. TRL
- b. Methodology
- c. Design & development
- d. Facilities and Instrumentation required
- e. Consumables (Scientific materials)

b. Industry/Institute Collaboration If, yes

- a. Name of the Collaborating Industry/Institute
- b. Collaboration Details
- c. Additional Details if any

c. Funding required from I-STEM (with justification)

- a. Funding required from I-STEM (with justification)
- b. Expected output and outcome
- c. Additional Details if any

k. Details of Institution's Bank Account:

(Please send a copy of the cancelled cheque and I-STEM ECS Form with PAN, GSTIN and Registration Certificate (if any) carrying all the information needed)

Beneficiary Name Weedy Software Pvt Ltd

GSTIN: 29AADCW1727E1ZD

PAN: AADCW1727E

Bank Account No.: 922020012596783

Name of the Branch: Axis Bank, MG Road, Bangalore

IFSC Code: UTIB0000009

Type of Bank Account: Current

Note: The users will submit the original invoice (duly approved by the Head of the Institution/Start-ups) raised by the Host Institution through Speed post to the Nodal Officer, I-STEM, Indian Institute of Science, Bangalore.

Note: A scan copies of all the bills must be uploaded to the portal.

PI declares that

1. the proposed project is checked using the available software for plagiarism and it is not copied in any form from the other resources/project.
2. This is completely new idea which need to be developed especially for the Indian Society.
3. No idea/contents without acknowledgement is/are used to prepare the proposal.

email: prajakta.sabnis@oorja.energy



Signature

All the PIs, I-STEM Representative, Head of Department, Head of Institution