

Subject: Proposal for Development of AI/ML-Based Models for Efficient Surface Engineering Processes (RES-URSC-2023-002)

Dear [Name of the Receiver],

I am writing to submit a proposal for the research project titled "Development of Artificial Intelligence (AI)/Machine Learning (ML)-based models for efficient surface engineering processes" under the reference RES-URSC-2023-002. I am excited about the opportunity to contribute to this cutting-edge project and collaborate with U R Rao Satellite Centre in Bengaluru.

Objective:

The development of industrial coating processes for tool coatings by means of physical vapor deposition (PVD) and chemical vapor deposition (CVD) is usually extremely complex. This complexity arises from the numerous degrees of freedom for the process design and coating development, resulting from various process parameters. Coating formation is influenced by parameters like ion bombardment time, sub-layer roughness, material type, sub-layer temperature, work and chamber pressure. Consequently, coating development is either based on experiential knowledge or significant effort in necessary coating batches until suitable process parameters are found. Artificial intelligence-based approaches are capable of describing complex relationships between various characteristic process values in record time and can be utilized for planning the values of different parameters of different vapor deposition surface engineering processes.

The primary goal of our proposed research is to leverage Artificial Intelligence (AI) and Machine Learning (ML) techniques, such as ensemble-based methods like bagging and boosting, and Bayesian-based models like artificial neural networks and others for optimizing and streamlining surface engineering processes. We specifically focus on conversion coatings, electroplating, paintings, and thin film technologies. We aim to provide an efficient method that reduces resource consumption and turnaround time during the development and characterization of these crucial processes.

Our main focus is on the development of state-of-the-art models that require fewer computational resources and time to find an optimum set of values required for the coating process. We also emphasize the precision and accuracy of the model, designing it to be utilized for daily industrial use.

Research Approach:

Our research approach involves the following two key approaches Ensemble (Bagging and boosting) based models and Bayesian models.

Some of the models that we are planning to experiment with are:

1. Random Forest
2. AdaBoost
3. Gradient Boosting
4. XGBoost
5. Artificial Neural Network

Developed models will undergo sensitivity studies, ensuring robustness and adaptability to different scenarios. Rigorous testing will ensure the reliability and accuracy of the AI/ML-based models in real-world applications.

Expected Deliverables:

Upon successful completion of the project, we commit to delivering the following:

Prescriptive Data Analytics Results  
Model Sensitivity Analysis Results  
Validated Model  
Final Closure Report

Timeline:

The proposed project is expected to be completed within the timeframe of 6 months.

Budget:

We currently anticipate no budget requirement, as our institution has GPUs available on campus, and other required facilities are also available. If any additional budget is required, we will notify the corresponding authorities.

Team Members:

Our team comprises experienced researchers, faculty members, and students with expertise in AI/ML.

The collaborative effort between academia and U R Rao Satellite Centre will ensure a holistic and comprehensive approach to addressing the project objectives. We are confident that our proposed research will make significant contributions to the efficiency and effectiveness of surface engineering processes critical for space applications. We look forward to the opportunity to collaborate with U R Rao Satellite Centre on this groundbreaking project.

Thank you for considering our proposal. We are available at your convenience for any further discussions or clarifications.

Sincerely,

[Your Full Name] [Your Contact Information]