Environmental Pollution Modelling for Electric Power Industry

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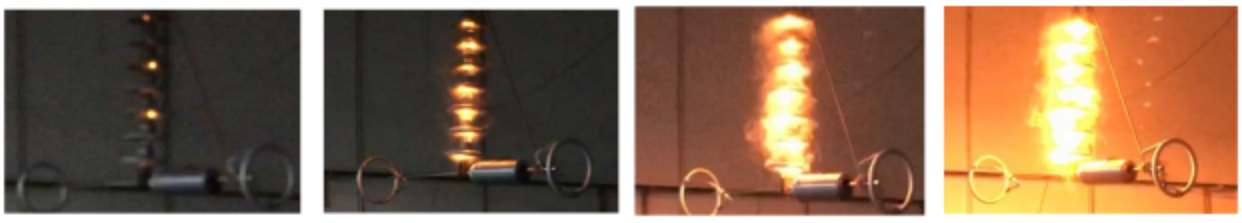
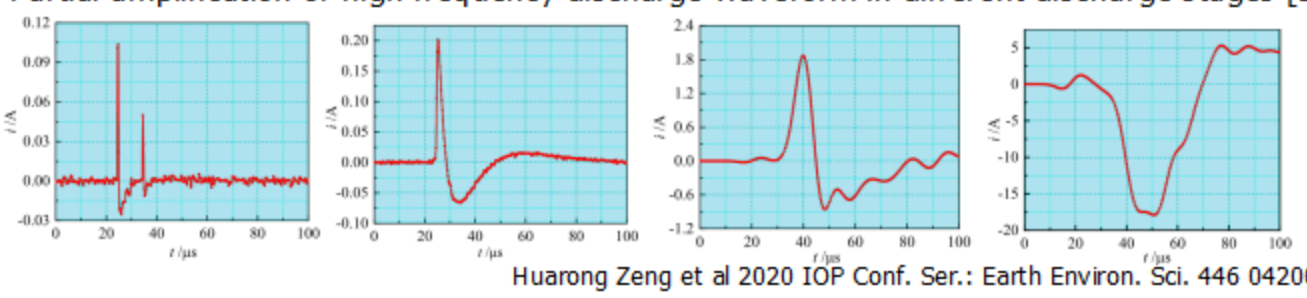
Electric power industry domain; Prevention of flashovers and consequent damage

Discharge phenomena at different discharge stages [3]



(a) Safety Zone, (b) Forecast Zone, (c) Danger Zone, (d) Flashover

Partial amplification of high frequency discharge waveform in different discharge stages [3]



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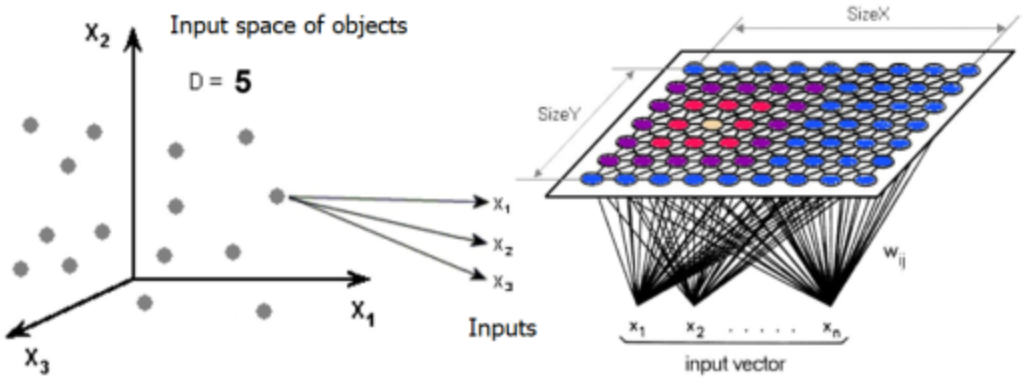
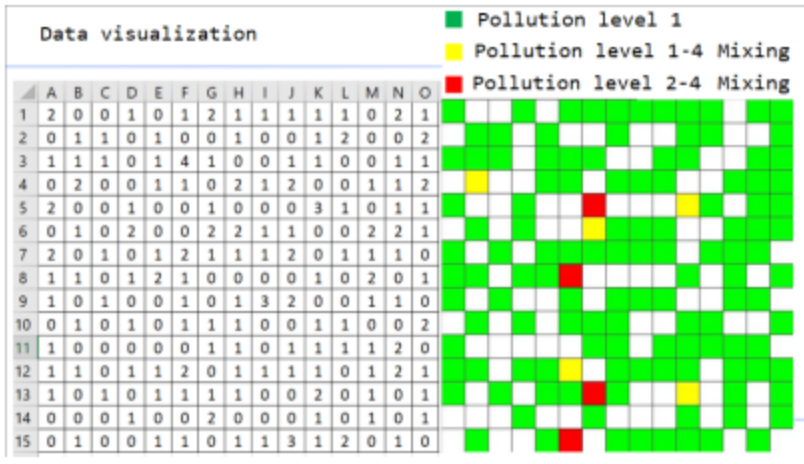
- Project Arien funded APVV-20-0548

Important process characteristics:

* strong stochasticity
* multiple significant influences: weather (wind / rain), pollution sources: Industry, Transport, Agriculture...
* multiple input attributes with varying properties: small particulate matter PM10, PM2.5, Total Suspended Particulate (TSP)
* different behaviour for dry/wet deposition
* small number of available field-measured samples (the measuring proces is extremely time consuming)

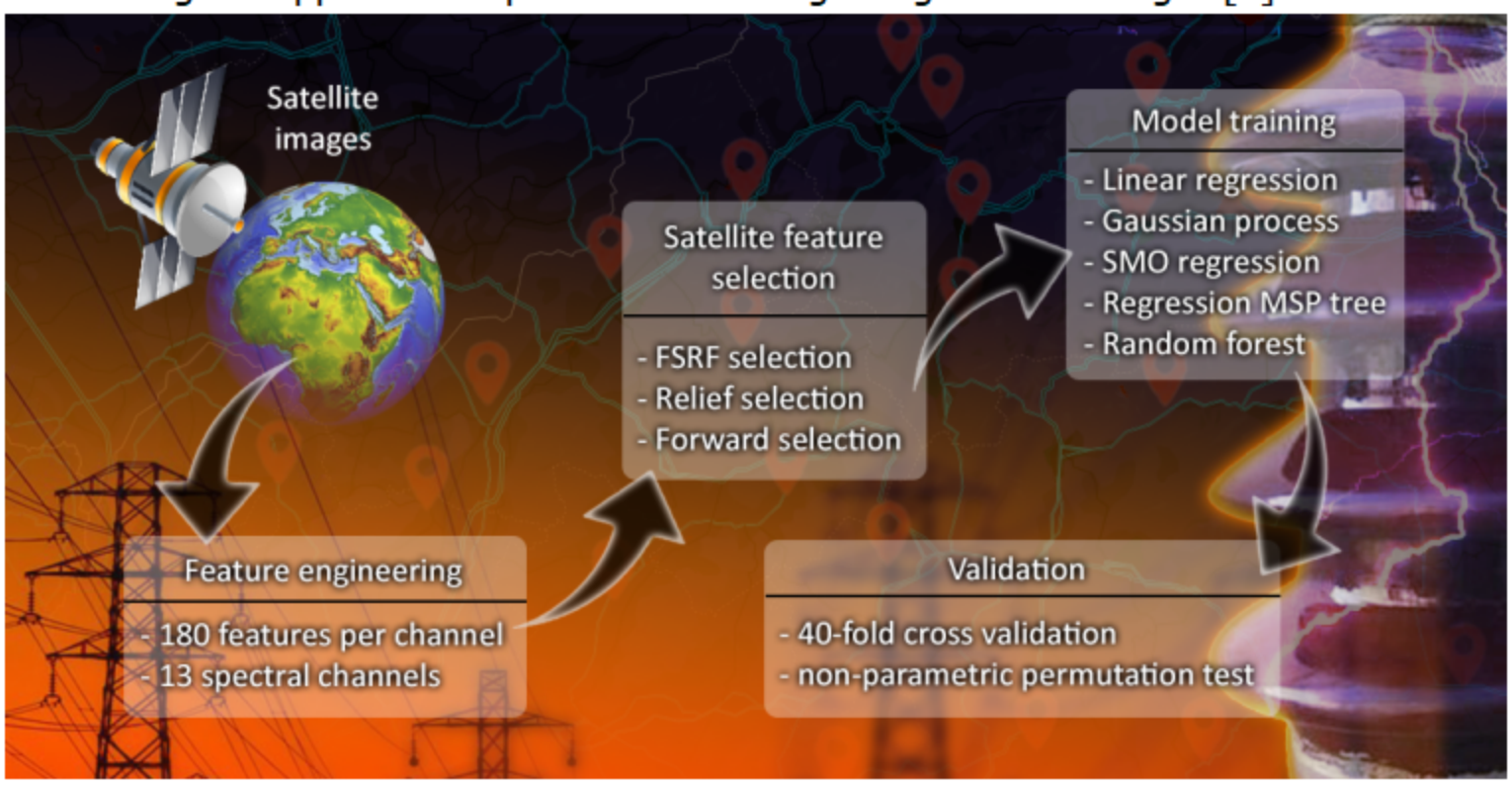
Application of Self-Organizing Maps





Problematic generalization of common characteristics (red and yellow squares do not cluster together, but are almost randomly distributed)

Designed Approach for pollution modelling using satellite images [1]



Overview of trained regression models and their accuracy metrics for target variable g02 (Electrical Conduction).

Models using attributes SHMU, Satellites (Forward Selection 5 attr), DayOfYear					
	Linear Model	Gaussian Proces	SMO Regression	M5P Tree	Random Forest
Correlation coefficient	0.5562	0.5565	0.5305	0.6058	0.6434
Relative absolute error	0.827117	0.82688	0.835880	0.788339	0.761934
Root relative sq. error	0.830543	0.829219	0.852279	0.795252	0.764349

Conclusions

Our research defined an approach using attributes from satellite images, attribute selection, as well as suitable methods of model training and validation.
The addition of attributes from satellite images allowed us to increase the accuracy of our regression models of pollution, despite the significant stochastic aspects of the task.

References

1. Krammer, Kvassay, Mojžiš, Kenyeres, Očkay, Hluchý, Pavlov, Skurčák: Using Satellite Imagery to Improve Local Pollution Model for High-Voltage Transmission Lines and Insulators, Future Internet 2022, https://doi.org/10.3390/fi14040099
2. Krammer, Kvassay, Očkay, Forgáč, Hluchý: Regression Analysis and Modeling of Local Environmental Pollution Levels for the Electric Power Industry Needs, Computing and Informatics 2022, ISSN 2585-8807.
3. Huarong Zeng, Fali Tan, et al: Experimental Study on High Frequency Pulse Current Variation Characteristics of Pollution Discharge of Insulators, 2020 IOP Conf. Ser. Earth Environ. Sci. 446 042006.