

## SELECTION OF INFORMATIVE WAVELENGTHS IN HYPERSPETRAL IMAGE ANALYSIS TO DETERMINE THE CONTENT OF NITROGEN COMPOUNDS IN SOIL SAMPLES <sup>11</sup>

---

**Georgi Manchev**

Department of Automatic and Electronics,  
“Angel Kanchev” Univesity of Ruse  
E-mail: gmanchev@uni-ruse.bg

**Assoc. Prof. Stanislav Penchev, PhD**

Department of Automatic and Electronics,  
“Angel Kanchev” Univesity of Ruse  
E-mail: msp@uni-ruse.bg

**Principal Asst. Prof. Eleonora Nedelcheva, PhD**

Department of Automatic and Electronics,  
“Angel Kanchev” Univesity of Ruse  
E-mail: ekirilova@uni-ruse.bg

**Assoc. Prof. Tsvetelina Georgieva, PhD**

Department of Automatic and Electronics,  
“Angel Kanchev” Univesity of Ruse  
E-mail: cgeorgieva@uni-ruse.bg

**Prof. Plamen Daskalov, PhD**

Department of Automatic and Electronics,  
“Angel Kanchev” Univesity of Ruse  
E-mail: daskalov@uni-ruse.bg

**Abstract:** *The article reviews existing popular solutions for wavelength selection and shows the possibilities of using Machine Learning models as a quick feedback and assessment in the analysis of spectral data for determining the nitrogen content in synthetic soil samples. The goal was to verify the possibilities for quantitative assessment of nitrogen content in samples captured with a hyperspectral camera in the near infrared region, using modern open-source solutions and tools. Data processing and analysis were performed using Orange software, with special attention paid to the built-in tools and methods for determining informative wavelengths. As a result of the experiments, the effectiveness of the applied solutions for determining nitrogen in soil samples and the potential for future development by upgrading the functionality of the used software package were confirmed.*

**Keywords:** *Hyperspectral Imaging, Near-Infrared, Machine Learning, Wavelength selection, Orange.*

This paper is awarded with the “**Best Paper**” **Crystal Prize** and is published in the compiled proceedings “Best Papers of the 63-th Science Conference of the University of Ruse”.

---

<sup>11</sup> The paper was presented on 25 October 2024 in section "Electrical Engineering, Electronics and Automation" with original title in English: SELECTION OF INFORMATIVE WAVELENGTHS IN HYPERSPETRAL IMAGE ANALYSIS TO DETERMINE THE CONTENT OF NITROGEN COMPOUNDS IN SOIL SAMPLES

## ACKNOWLEDGMENTS

The report reflects the results of the work on project No. 24-FEEA-05, financed by the "Scientific Research" fund of the University of Ruse, Bulgaria.

## REFERENCES

- Chang, C., Laird, D. & Hurburgh, C. (2005). Influence of soil moisture on near-infrared reflectance spectroscopic measurement of soil properties. *Soil Science*, 170(4), 244-255
- Cordella, C. (2012) PCA: The Basic Building Block of Chemometrics. *Analytical Chemistry*. InTech. Available at: <http://dx.doi.org/10.5772/51429>.
- Dardenne, P., Sinnaeve, G. & Baeten, V. (2000). Multivariate calibration and chemometrics for near infrared spectroscopy: which method?, *Journal of Near Infrared Spectroscopy*, 8, 229-237.
- Ma, Y., Minasny, B., Demattê, J. & McBratney, A. (2023). Incorporating soil knowledge into machine-learning prediction of soil properties from soil spectra. *European Journal of Soil Science*, 74(6), e13438.
- Reda, R., Saffaj, T., Ilham, B., Saidi, O., Issam, K., Brahim, L. & El Hadrami, M. (2019). A comparative study between a new method and other machine learning algorithms for soil organic carbon and total nitrogen prediction using near infrared spectroscopy. *Chemometrics and Intelligent Laboratory Systems*, 195, 103873.
- Sarathjith, C., Das, S., Wani, P. & Sahrawat, L., (2016). Variable indicators for optimum wavelength selection in diffuse reflectance spectroscopy of soils. *Geoderma*, 267, 1–9.
- Wulfert, F., Kok, W. & Smilde, A. (1998). Influence of Temperature on Vibrational Spectra and Consequences for the Predictive Ability of Multivariate Models. *Analytical Chemistry*, 70(9), 1761-1767.
- Zhang, X., Xue, J., Xiao, Y., Shi, Z. & Chen, S. (2023). Towards Optimal Variable Selection Methods for Soil Property Prediction Using a Regional Soil Vis-NIR Spectral Library. *Remote Sensing*, 15(2), 465.