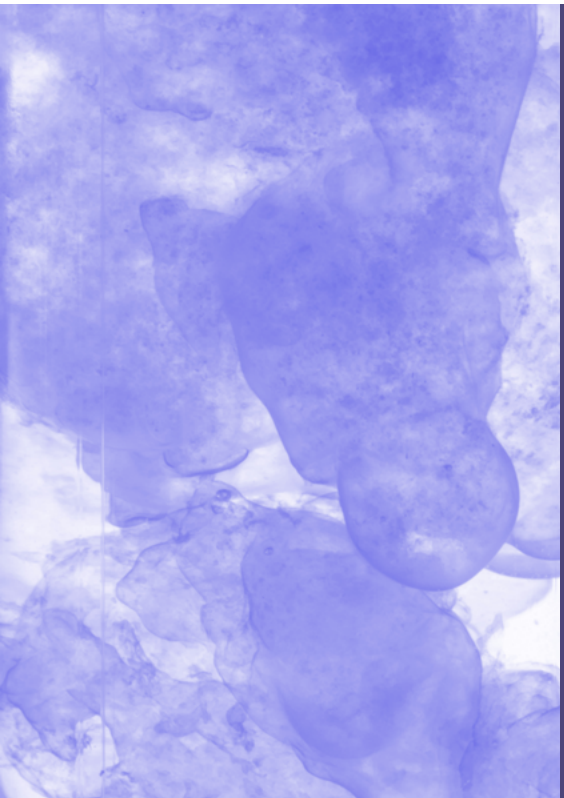
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Selected Papers



Exploring Chemistry in Virtual Reality: A Comparative Analysis of VR Simulations for Chemistry Education

Authors: Jamshid Kayumov, Durbek Usmanov, Ugiloy Yusupova, Zulayho Smanova and Bakhtiyor Rasulev

Abstract: It is hard to envision a modern world where information technology does not facilitate daily tasks, including learning and teaching. This paper explores the use of virtual reality (VR) simulations in chemistry education, focusing on how immersive VR environments can enhance the learning experience for students. With chemistry often posing challenges due to its abstract and complex concepts, VR technology allows for a more interactive and visual approach, enabling students to visualize molecular structures, chemical reactions, and laboratory procedures. The study concludes that virtual reality (VR) simulations are crucial in modernizing chemistry education by making abstract and complex concepts more interactive and visual. Through a comprehensive analysis of current VR tools and simulations, the article discusses their strengths and limitations, providing a critical overview of the role of VR in modernizing chemistry education. The findings suggest that VR simulations can significantly improve students' engagement with and understanding of complex chemistry concepts. Also, the results suggests that integrating VR into chemistry education can revolutionize traditional teaching methods, providing a more immersive and engaging learning experience.

https://doi.org/10.3390/app152413254



Machine Learning-Based Material Thickness and Type Classification via Scattering Parameters

Authors: Mustafa Alptekin Engin and Mehmet Cakir

Abstract: The precise determination of material type and thickness is of major significance in non-destructive testing, quality assurance, and materials science, as it influences the functionality, reliability, and performance of materials in engineering applications. This study proposes a methodology for the classification of material thickness and type through the analysis of scattering parameters within the 8–12 GHz frequency range. A database was created, encompassing real, imaginary, and dB values of reflection and transmission parameters for nine real-world materials with thicknesses ranging from 1 to 10 mm. This study addressed two main classification tasks, namely material thickness and material type. A variety of training–testing splits were employed in conjunction with 10-fold cross-validation to facilitate a comparison of classifier performance. In the material type classification, incorporating multiple thickness levels of each material enabled the model to distinguish materials with similar reflection characteristics more accurately, thereby enhancing discrimination performance. The results showed that Fine KNN consistently achieved 100% accuracy in thickness classification, while Quadratic SVM achieved 100% accuracy in material type classification, even when utilising only three thickness levels....

https://doi.org/10.3390/app16010391



Major Depressive Disorder Diagnosis Using Time–Frequency Embeddings Based on Deep Metric Learning and Neuro-Fuzzy from EEG Signals

Authors: A-Hyeon Jo and Keun-Chang Kwak

Abstract: Major depressive disorder (MDD) is a prevalent mental health condition that requires accurate and objective diagnostic tools. Electroencephalogram (EEG) signals provide valuable insights into brain activity and have been widely studied for mental disorder classification. In this study, we propose a novel DML + ANFIS framework that integrates deep metric learning (DML) with an adaptive neuro-fuzzy inference system (ANFIS) for the automated diagnosis of major depressive disorder (MDD) using EEG time series signals. Time–frequency features are first extracted from raw EEG signals using the short-time Fourier transform (STFT) and the continuous wavelet transform (CWT). These features are then embedded into a low-dimensional space using a DML approach, which enhances the inter-class separability between MDD and healthy control (HC) groups in the feature space. The resulting time–frequency feature embeddings are finally classified using an ANFIS, which integrates fuzzy logic-based nonlinear inference with deep metric learning. The proposed DML + ANFIS framework was evaluated on a publicly available EEG dataset comprising MDD patients and healthy control (HC) subjects. Under subject-dependent evaluation, the STFT-based DML + ANFIS and CWT-based models achieved an accuracy of 92.07% and 98.41% and an AUC of 97.28% and 99.50%, respectively....

https://doi.org/10.3390/app16010324



Technology-Enhanced STEM Physics Instruction: Self-Efficacy of Adult Learners in Second Chance Schools

Authors: Despina Radiopoulou, Charalampos Karagiannidis and Paraskevi Zacharia

Abstract: This study explores the impact of two teaching methods on the Self-Efficacy in Physics of adult learners in Greek Second Chance Schools (SCSs), an institution designed to promote Lifelong Learning. The participants were divided into two groups. The experimental group was taught selected Physics topics using a STEM-based approach, while the control group received instruction through traditional lectures. Quantitative data were collected using two reliable and validated structured questionnaires to assess the self-efficacy of adult learners prior to and following the instructional intervention. Findings reveal that the STEM-based approach led to a statistically significant improvement in self-efficacy beliefs among adult learners, with no differences observed by gender or age. This study highlights the value of integrating technology-enhanced STEM education into alternative education frameworks and provides a foundation for future investigations in adult education contexts through the application of innovative, learner-focused methodologies.

https://doi.org/10.3390/app152413019

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