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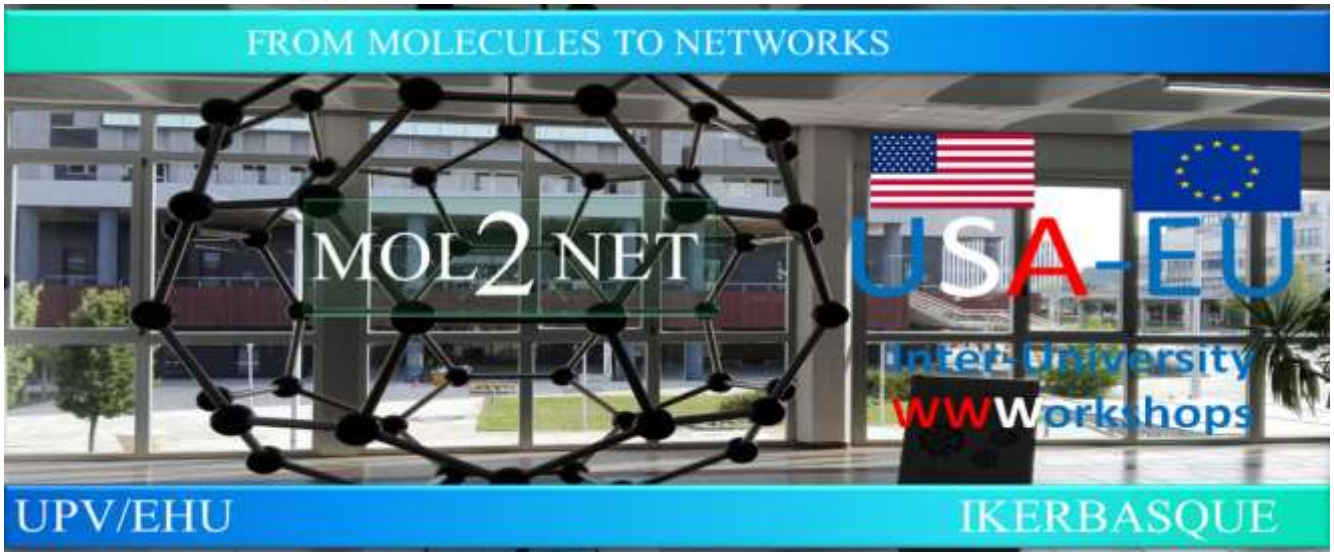

DADNP: Dual Antibacterial Drug-Nanoparticle Systems Machine learning Approach

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Graphical Abstract

Abstract.

The rise of new infectious diseases, combined with an increase in antibiotic resistance among bacterial pathogens, poses a significant health danger to humans. This ever-increasing threat of bacterial resistance necessitates the development of novel techniques to overcome this barrier. One of the successful strategies for combating antibiotic resistance has been the conjugation of nanoparticles (NPs) with antimicrobial moieties such as antibiotics, peptides, or other biomolecules. However, Dual Antibacterial Drug-Nanoparticle (DADNP) discovery is a slow

	process due to the high number of combinations of NP vs. AD compounds, assays, etc. Artificial Intelligence/Machine Learning (AI/ML) algorithms may speed up it if they predict which putative DADNP systems should be short listed for assay. Nevertheless, the low amount of DADNP activity indicates that AI/ML analysis is tough. To solve this problem in an additive manner, the IFPTML = Information Fusion (IF) + Perturbation-Theory (PT) + Machine Learning (ML) technique was applied. Two datasets were combined (>165000 ChEMBL AD experiments with 300 NP assays) against multiple bacteria species. Eleven non-linear ML algorithms were developed using the Waikato Environment for Knowledge Analysis (WEKA) and STATISTICA. The analysis of the values of all the IFPTML models (Training/Validation Series) presents good performances (Accuracy global of 88.8-98.3%), Similarly, AUROC values are high (92-99%) in most cases. In the analysis and comparison of the algorithms used, ANN, RF, and KNN models stand out as having the highest Sn ≈ Sp ≈ 88.5% - 99.0% and AUROC ≈ 0.94 - 0.99 in both series. These results suggest that the IFPTML models may become a useful tool in the design of DADNP systems for antibacterial therapy against multidrug-resistant microbiological infections.

Introduction

The main bibliographic sources used in this document are listed below [1-15].

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