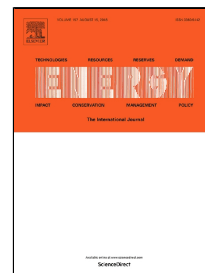


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A novel robust ensemble model integrated extreme learning machine with multi-activation functions for energy modeling and analysis: Application to petrochemical industry



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1 **A novel robust ensemble model integrated extreme learning machine with multi-activation**
2 **functions for energy modeling and analysis: Application to petrochemical industry**

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9 **ABSTRAT:** With the increasing complexity of energy modeling data, it becomes more and more demanding to
10 build a robust and accurate energy analysis model using a single neural network. To deal with this problem, a
11 novel robust ensemble model integrated extreme learning machine with multi-activation functions is proposed
12 to develop robust and accurate energy analysis models. There are two salient features in the proposed model:
13 one is that different effective nonlinear activation functions are adopted in extreme learning machine to
14 enhance the ability in dealing with the high nonlinearity of energy modeling data, i.e. multi-activation functions
15 are utilized; the other salient feature is that several single models with different effective nonlinear activation
16 functions are combined to build an ensemble model for enhancing the performance in terms of accuracy and
17 stability, i.e. the generalization and robustness capability of the proposed model is much improved through
18 aggregating multiple activation functions based extreme learning machine models. To verify the performance
19 of the proposed model, two case studies of developing energy analysis models for complex chemical processes
20 are carried out. Simulation results demonstrate that the proposed model achieves high accuracy and good
21 stability.

22 **Keywords:** Energy modeling and analysis; Ensemble model; Extreme Learning Machine; Multi-activation

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