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DNN based Predictive modelling for determination of Material Properties

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Analytical models are ineffective in estimation of effective medium properties of rocks due to the complex porous-structure at the macro and micro level. This is particularly severe in carbonate rocks, which results in poor understanding of seismic responses. Thus there is a strong reason for development and study of new models to understand wave propagation through rocks. Discrete Element Method (D.E.M) can be used to model the micro-structure of grains in carbonate rocks and has been done previously. Signal processing tools can then be employed to understand the seismic/dynamic responses of the material. A synthetic model of one dimensional chain of discrete elements/particles is used to generate space time responses when impulse moves along the chain, providing information about the longitudinal wave propagation (P-wave). The results show that capturing the disorder parameter can be accomplished using Deep Neural Networks (DNN). Feature engineering part is suitably taken care of by the usage of deep nets. The features capturing various aspects of the texture summarize the content. These space time responses obtained from the synthetic model are fed to a Deep Neural network (DNN) to obtain the properties of the media (particle size/mass distribution of the chain). Multiple hidden layers learn various features efficiently obtaining a coefficient of regression value of 0.94. Finally, the importance of DNN as a signal processing tool is discussed upon.