STATISTICAL APPROACHES FOR PREDICTION OF JOINT LOCATION MODELS FOR FRACTURED ROCKS.

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Characterization of fractured rocks demands for reliable conceptual models of joint/fracture properties. This is of particular concern in the fields of reservoir engineering or stability risk assessment for underground excavations. Physical and hydrological properties of joints are combined to derive a three-dimensional discrete fracture network. The common problem, however,is to describe joint spatial nature when only one-dimensional data (borehole) are available. In this study, several statistical approaches for deriving spatial pattern of fracture locations were tested. Two synthetic, three-dimensional fracture models with different fracture location patterns were generated with FracMan (fracture numerical simulator) and a simulated borehole sampling was performed. The first model was based on random fracture location in space (Poisson process). The second model generated stochastic fields according to constraints such as spatial correlation; i.e. fractures were not homogeneously distributed but formed clusters. For both models fracture locations in the borehole were analyzed to see how one-dimensional spatial variability relates to three-dimensional fracture field. Empirical survivor function for fracture spacing as well as serial correlation showed clear difference between the models. Also the autocorrelation function for fracture density showed different trends. However, the most evident contrast was revealed from spectral density analysis. It was also found that for the clustered model, fractures in the borehole followed Markov process while for the random model they did not. Since fracture spatial pattern in the borehole could be statistically described, the possibility exists to infer about conceptual three-dimensional location models and to predict fracture spatial variability in unlogged borehole sections.