Forward modeling for characterizing rock fracture properties by using electromagnetic FDTD method

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River Nile represents the main source for water supply in Egypt where 95% of water usage like agriculture, industry and drinking purposes depends on it. These days, Egyptian government urges the Egyptian society for rationalizing water usage and in the same time the researcher to find other water resources one of them is groundwater. Large percentage of groundwater in Egypt is found in limestone and igneous rocks which are mainly fractured types.

Our lab has developed a full polarimetric borehole radar system that represents one of the effective tools for subsurface rock fracture characterization. This property of borehole radar enables it to be applied in different applications such as groundwater monitoring specially for fractured rocks. In spite of the measurements uniqueness of full polarimetric borehole radar but still we do not figure out the scattering properties of electromagnetic waves due to fracture roughness category. For that reason, We employed forward Finite Difference Time Domain simulation for a created known fractal surface fractures ,fractal dimension is the closest resemble property for the real fractures in nature, to validate the measured full polarmetric data as we cannot see the fracture in subsurface. By comparing the simulation results of rough aperture with flat fracture aperture we found that the cross polarization components VH and HV increasing proportionally with fracture RMS height roughness.