Investigating the Hammerstad - Jensen Formula for High Permittivity Materials

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Abstract—
Recently there is a great interest in high permittivity substances for reducing the size of printed antennas, microwaves circuits and components [1]. For a long time, since the advent of this technology, it is a common practice to use the well-known simple formula of E. Hammerstad and O. Jensen for calculating the effective permittivity of microstrip structures [2]. It is shown, by applying HFSS simulation for the spectral dependence of the S_{21} phase of high permittivity microstrip line, that this formula is no longer valid. The Hammerstad- Jensen formula precisely fits the EM simulation results only at low permittivity levels, but for high permittivity levels it turns out that the simulated values are slightly higher than the values resulted by the formula.