Compact mode-matched excitation structures for radar distance measurements in overmoded circular waveguides

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Radar systems are commonly utilized for high-precision distance measurements in an industrial environment in free-space applications, e.g. for tank level control of liquid materials. If these measurements are conducted in overmoded circular waveguides like large metal tubes, which is an upcoming important application for industrial radar systems, the accuracy of the measurements is significantly deteriorated compared to the free-space application. This is caused by the appearance of higher order modes and multi-mode propagation in the metal tube.

Hence, this contribution investigates novel approaches for a broadband mode-matched transition between waveguides with different diameters of the cross section. The structures are optimized with respect to the conservation of the electro-magnetic field distribution between a small circular waveguide and a large circular waveguide, e.g. providing solely the excitation of the fundamental mode in an overmoded waveguide. Realistic applications limit the space requirements of such transition geometries which results in a high demand for compact mode-matched structures. The obtained improvements in terms of the overall radar system performance are demonstrated both by simulation and measurements.