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Teaching Applications of Complex Variable Theory for Courses in Applied Electromagnetics

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Complex variable theory is a valuable analytical tool that can give important insight into the solution of problems encountered in graduate courses that address difficult problems in applied electromagnetics. A good example of an application pertains to the solution of the fields radiated by patch antennas. Advanced analytical techniques for analyzing these devices employ spectral domain solutions which require two-dimensional inverse transforms to recover the spatial solutions for the radiated fields. Employing the techniques of path-deformation, one can obtain expressions for radiated fields, surface waves, and leaky waves. Students with sufficient exposure to complex variable theory find little difficulty applying the theory to the solution of these problems when given various integration paths. However, the introduction of branch cuts that have a meaningful interpretation to the electromagnetic problem at hand can be the most challenging component for learning these techniques and fully understanding the analytical details.

This presentation will detail how the concept of branch cuts may be introduced and taught in a way that has meaningful interpretations for solution of problems that employ the spectral domain technique as taught in the classroom environment. Once done, proper and improper Riemann sheets can be defined, and the interpretation of various path deformations can be introduced. Of course, these solutions are well-known and can be found in the literature [1-3]. The presentation addresses the challenges of teaching these solutions that are complex in their formulation.

References

[1] L. B. Felsen and N. Marcuvitz, *Radiation and Scattering of Waves*, Engelwood Cliffs, N. J: Prentice Hall, 1973.

[2] G. Tyras, *Radiation and Propagation of Electromagnetic Waves*, New York: Academic Press, 1969.

[3] A. Ishimaru, *Electromagnetic Wave Propagation, Radiation, and Scattering*, Engelwood Cliffs, N. J.: Prentice Hall, 1991.