Some Electromagnetic Wave Propagation Models for Moving Media: An Operator Theoretical Perspective.

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The study of Maxwell's equations in moving media is of long standing interest, beginning with J. C. Maxwell himself. We consider Maxwell's equations with a drift term (Maxwell-Hertz-Cohn model) as our starting model for such situations and inspect its connection to the Maxwell-Minkowski model, which has replaced it, in an operator-theoretical framework. By discussing these models in a common *normal form*, following the ideas of *[1], [2, Chapter 6]*, we are able to conveniently compare these approaches. The Maxwell-Hertz-Cohn model suggests a velocity constraint by the speed of light, which was a strong motivation for the Maxwell-Minkowski model, where this constraint is actually built into the Minkowski structure of space and time. In the light of this historical link it may be interesting that – as we will show – the constraint in the Maxwell-Hertz-Cohn model to media moving slower than the speed of light is a mathematical artifact.

References

[1] R. Picard. A Structural Observation for Linear Material Laws in Classical Mathematical Physics. *Math. Methods Appl. Sci.*, 32(14):1768–1803, 2009.

[2] R. Picard and D. F. McGhee. *Partial Differential Equations: A unified Hilbert Space Approach*, volume 55 of *De Gruyter Expositions in Mathematics*. De Gruyter. Berlin, New York, 2011.