Beyer

Beyond Partial Differential Equations

On Linear and Quasi-Linear Abstract Hyperbolic Evolution Equations

Semigroup Theory uses abstract methods of Operator Theory to treat initial bou- ary value problems for linear and nonlinear equations that describe the evolution of a system. Due to the generality of its methods, the class of systems that can be treated in this way exceeds by far those described by equations containing only local op- ators induced by partial derivatives, i.e., PDEs. In particular, that class includes the systems of Quantum Theory. Another important application of semigroup methods is in ?eld quantization. Simple examples are given by the cases of free ?elds in Minkowski spacetime like Klein-Gordon ?elds, the Dirac ?eld and the Maxwell ?eld, whose ?eld equations are given by systems of linear PDEs. The second quantization of such a ?eld replaces the ?eld equation by a Schrodinger ¨ equation whose Hamilton operator is given by the second quantization of a non-local function of a self-adjoint linear operator. That operator generates the semigroup given by the time-development of the solutions of the ?eld equation corresponding to arbitrary initial data as a function of time.

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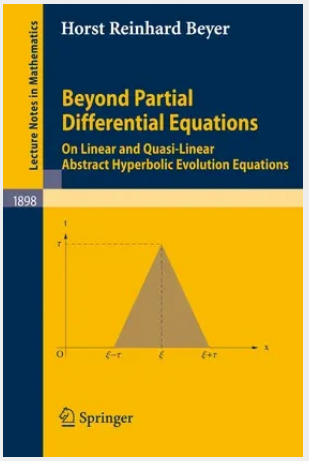

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