Preface

The aim of the current work is to present an autonomous theory of harmonic functions on infinite networks akin to potential theory on locally compact spaces as developed primarily by Brelot (without sanctioning any explicit role for the derivatives of functions defined on the space). Though random walks and electrical networks are two important sources for the advancement of the present theory, neither probabilistic methods nor energy integral techniques are used here to prove the results in an infinite network. The relevance of this study is partly because in many infinite networks (like homogeneous trees, for example), any real-valued function defined on the network is a difference of two superharmonic functions.

We consider principally the classification theory of infinite networks based on the existence of Green functions, bounded harmonic functions etc., and then balayage, equilibrium principle, domination principle, Schrödinger operators, polyharmonic functions and the Riesz-Martin compactification of the network. An important feature is the study of parabolic networks. These are the networks on which no positive potentials exist or equivalently, these are the networks on which the Green function cannot be defined. On parabolic networks we investigate the properties of pseudo-potentials (analogous to logarithmic potentials on the complex plane) introduced via a development of a notion of flux.

My sincere thanks go to the referees who read the manuscript and made valuable comments.

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March 2011

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http://www.springer.com/978-3-642-21398-4

Harmonic Functions and Potentials on Finite or Infinite Networks

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2011, X, 141 p., Softcover
ISBN: 978-3-642-21398-4