AN INVERSE PROBLEM FOR A MODEL OF SCATTERED AND DIFFUSED RADIATION

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1. INTRODUCTION

There would be many obvious practical applications for any scheme capable of achieving similar goals to, for example, transmission X–ray tomography, but by using instead *low energy* radiation. For example, certain wavelengths of infrared radiation pass easily through human flesh to reveal quite distinct shadow graphs of skeletal structure. Thus diagnostic medical imaging is one possible application. In transmission X–ray tomography, the high energy X–rays travel in essentially straight lines suffering only attenuation, so that the radiation path is known. The immediate problem confronting any attempt at low energy tomography, is that the radiation path is unknown. The low energy radiation is scattered and diffused throughout any body upon which it is incident. Certainly, the radiation paths are not straight lines, or more generally, regularly embedded submanifolds or geodesics for the prevailing metric on the ambient space. This unfortunate fact makes the significant tools of integral geometry, such as the Radon transform which is used with great success for X–rays [3], essentially useless for weak radiation. Conventional mathematical tools having been cast aside, we are forced to take a wider point of view than in classical tomography and construct a first principles model of the radiation–matter interaction.

In this paper, we discuss a discrete model for the passage of low energy radiation through a body, together with the resulting inverse problem coming from trying to reconstruct internal properties of absorption and scattering of the body. We propose a model for the passage of radiation through a discrete lattice of pixels, the radiation being allowed to scatter from the