1077-80-2766 **B S Tilley*** (tilley@wpi.edu), Dept. Mathematical Sciences, 100 Institute Rd, Worcester, MA 01609. *Mathematical Problems in Residential Geothermal Heating Systems.*

Although the promise of environmentally friendly, low-cost energy harvesting for heating and cooling of residential properties has been known for nearly 30 years, the adoption of the technology has been slow in the United States. These geothermal systems, known as ground-source heat pumps (GSHP), consist of a field of vertical boreholes in the ground with pipes carrying a heat transfer fluid into the earth to gain access to the stable year-round temperatures underground. However, a significant portion of the cost of these systems is in the installation of the pipes, with a return on investment on the order of 8-10 years. The main cost in the installation is the depth of the boreholes. We focus on this talk on systems with a concentric geometry. Fluid from the residence flows down the center tube, and returns in the annular region between the inner and outer tubes. In the case of an uniform annular spacing, spectral methods give a characteristic value that determines the length-scale over which thermal exchange takes place. This length is optimized when the gap thickness of the annulus is minimized. Preliminary results on variable annular thicknesses is also presented. This work is done in collaboration with the New England Geothermal Professionals Association (NEGPA). (Received September 22, 2011)