

# Radiative Transfer in Porous Media

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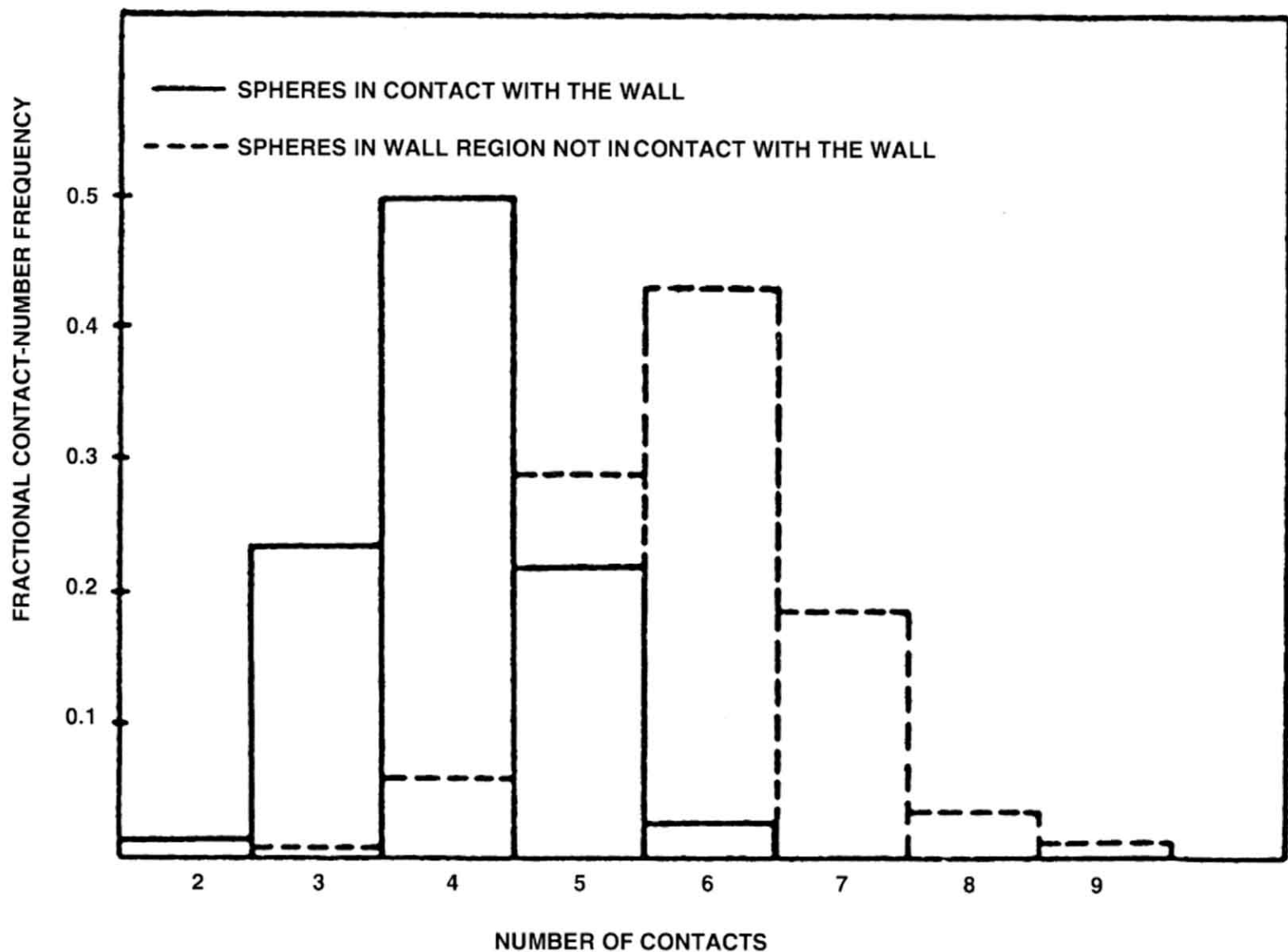
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## I. INTRODUCTION

Radiative transport in porous media has important engineering applications in: combustion; heat exchangers for high temperature applications, including solar collectors; regenerators and recuperators; insulation systems; packed and circulating bed combustors and reactors; manufacturing and materials processing; and proposed energy storage and conversion methods.

In many of these applications, the porous medium acts as a means to absorb or emit radiant energy that is transferred to or from a fluid. Generally, the fluid itself (particularly if it is a gas) can be assumed to be transparent to radiation, because the dimensions for radiative transfer among the solid structure elements of the porous medium are usually much less than the radiative mean free path for scattering or absorption in the fluid. In other applications, no fluid is present and the heat transfer at high temperatures is by a combination of radiative and conductive transfer. There are also cases where the energy transfer among the particles and with the surrounding is by radiation alone, which is the case for some designs of space radiator where fluid particles are transmitted from a nozzle to a collection device, and are allowed to cool by radiative loss before being recycled.

Reviews by Vortmeyer (1978), Tien (1988), Kaviany and Singh (1993), Dombrovsky (1996), and Baillis-Doermann and Sacadura (1998) provide excellent recent overviews of radiative transfer in porous and dispersed media, along with extensive bibliographies covering pertinent literature. This chapter concentrates on recent developments and applications where radiative transfer in porous materials is an important effect.



**Figure 7.** Frequency distribution of number of contacts with adjacent spheres in a randomly packed bed: near boundary, solid lines; bed interior, dashed lines (Yang 1981).