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ALTERNATING ROBIN–NEUMANN BOUNDARY VALUE PROBLEM AS A MODEL FOR TRANSPORT THROUGH BIOLOGICAL MEMBRANES

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Abstract: It is known that transport of chemical species through biological membranes often can not be modelled by standard diffusion through openings (*pores*, or channels) in the membrane. Actually, it has been observed that in many physical situations, pores alternate between two states (*open* and *closed*), either periodically or according to a random scheme. As shown by Andreucci–Bellaveglia in a previous paper through homogenization techniques, the limiting behavior of problems of this kind sharply depends on the relative scalings of the time and space variables. Here, having in mind a model of cell absorption of a selected protein or drug, we consider the homogenization of a parabolic problem in a perforated domain with Robin–Neumann boundary conditions oscillating in time. Such oscillations must compensate the blow up of the boundary measure of the holes.

We use the technique of time–periodic unfolding in order to obtain a macroscopic parabolic problem containing an extra linear term due to the absorption determined by the Robin condition. Our approach is based on the results obtained in a previous paper of the same authors, where the time-periodic unfolding operator is introduced, inspired by the operators of space-periodic unfolding introduced and applied by Cioranescu, Damlamian, Donato, Griso, Onofrei, Zaki in some quite recent researches.

Finally, we identify two possible limiting behaviors depending on the relative magnitude of the time-period of the oscillations and the diameter of the holes and spatial period of the lattice.