

The first part of the paper is devoted to the study of the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$. In the second part, we study the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$. In the third part, we study the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$.

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2. STATEMENT OF THE PROBLEM

Let Ω be a bounded domain in \mathbb{R}^n with smooth boundary $\partial\Omega$. Let Γ be a smooth curve in Ω . Let \mathbf{u} and \mathbf{v} be vector fields in Ω . Let \mathbf{u}_ϵ and \mathbf{v}_ϵ be vector fields in Ω depending on a small parameter ϵ .

2.1. Asymptotic expansion

We seek an asymptotic expansion of the solutions \mathbf{u}_ϵ and \mathbf{v}_ϵ in powers of ϵ . Let \mathbf{u}^0 and \mathbf{v}^0 be the leading order terms. Let \mathbf{u}^1 and \mathbf{v}^1 be the first order correction terms. Let \mathbf{u}^2 and \mathbf{v}^2 be the second order correction terms.

The asymptotic expansion of \mathbf{u}_ϵ and \mathbf{v}_ϵ is given by

$$\mathbf{u}_\epsilon = \mathbf{u}^0 + \epsilon \mathbf{u}^1 + \epsilon^2 \mathbf{u}^2 + \dots$$

$$\mathbf{v}_\epsilon = \mathbf{v}^0 + \epsilon \mathbf{v}^1 + \epsilon^2 \mathbf{v}^2 + \dots$$

The leading order terms \mathbf{u}^0 and \mathbf{v}^0 satisfy the system

$$\operatorname{div} \mathbf{u}^0 = \mathbf{f}$$

$$\operatorname{div} \mathbf{v}^0 = \mathbf{g}$$

in Ω , where \mathbf{f} and \mathbf{g} are given vector fields. The first order correction terms \mathbf{u}^1 and \mathbf{v}^1 satisfy the system

$$\operatorname{div} \mathbf{u}^1 = \mathbf{h}$$

$$\operatorname{div} \mathbf{v}^1 = \mathbf{i}$$

in Ω , where \mathbf{h} and \mathbf{i} are given vector fields. The second order correction terms \mathbf{u}^2 and \mathbf{v}^2 satisfy the system

$$\operatorname{div} \mathbf{u}^2 = \mathbf{j}$$

$$\operatorname{div} \mathbf{v}^2 = \mathbf{k}$$

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