
Approximations to Perturbed Problems on Unbounded Domains

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In this talk, we investigate perturbed boundary value problems on unbounded domains. Since the feature of unbounded domain, regular perturbation methods that work in bounded domain may give false approximations or even claim non-existence of solution to the problem. We first re-visit the Lagerstrom's problem by providing a rigorous asymptotic expansion for the solution. Furthermore, near infinity, a trans-series asymptotic expansion of the solution is investigated, and the leading term coefficient is determined by a connection formula between the two points $r = 1$ and $r = \infty$. A further extension and discussion of the problem for $n \in [1, 2)$ is also presented.

The second problem is the perturbed Poisson-Boltzmann equation that describes potential outside a spherical domain in an electrolytic fluid. Rigorous approximation is given in terms of successive approximation method. A singular perturbed problem related to it is also considered.

This is a collaboration work with Prof. R. Wong.