<<多尺度模型的基本原理>>

图书基本信息

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内容概要

《数学与现代科学技术丛书6：多尺度模型的基本原理（英文版）》系统介绍有关多尺度建模的基本问题，主要介绍其基本原理而非具体应用。
前四章介绍有关多尺度建模的一些背景材料，包括基本的物理模型，例如，连续统力学、量子力学，还包括一些多尺度问题中常用的分析工具，例如，平均方法、齐次化方法、重正规化群法、匹配渐近法等，同时，还介绍了运用多尺度思想的经典数值方法。
接下来介绍一些更前沿的内容：多物理模型的实例，即明确使用多物理渐近的分析模型，当宏观经验模型不足时，借助微观模型，使用数值方法来获取复杂系统的宏观行为规律，使用数值方法将宏观模型和微观模型结合起来，以便更好地解决局部奇点、亏量及其他问题；最后一部分主要介绍三类具体问题：带多尺度系数的微分方程、慢动力和快动力问题以及其他特殊问题。

书籍目录

章节摘录

Chapter 1 Introduction 1.1 Examples of multiscale problems Whether we explicitly recognize it or not, multiscale phenomena are part of our daily lives. We organize our time in days, months and years, as a result of the multiscale dynamics of the solar system. Our society is organized in a hierarchical structure, from towns to states, countries and continents. Such a structure has its historical and political origin, but it is also a re ° ection of the multiscale geo- graphical structure of the earth. Moving into the realm of modeling, an important tool for studying functions, signals or geometrical shapes is to decompose them according to their components at di?erent scales, as is done in Fourier or wavelet expansion. From the viewpoint of physics, all materials at the microscale are made up of the nuclei and the electrons, whose structure and dynamics are responsible for the macroscale behavior of the material, such as transport, wave propagation, deformation and failure. In fact, it is not an easy task to think of a situation that does not involve any multiscale characteristics. Therefore, speaking broadly, it is not incorrect to say that multiscale modeling encompasses almost every aspect of modeling. However, with such a broad view, it would be impossible to carry out a serious discussion in any kind of depth. Therefore we will adopt a narrower viewpoint and focus on a number of issues for which the multiscale character is the dominating issue and is exploited explicitly in the modeling process. This includes analytical and numerical techniques that exploit the disparity of scales, as well as multi-physics problems. Here \multi-physics problems"" is perhaps a misnomer, what we have in mind are problems that involve physical laws at di? erent levels of detail, such as quantum mechanics and continuum models. We will start with some simple examples. 1.1.1 Multiscale data and their representation A basic multiscale phenomenon comes from the fact that signals (functions, curves, images) often contain components at disparate scales. One such example is shown in Figure 1.1 which displays an image that contains large scale edges as well as textures with small scale features. This observation motivated the decompo- sition of signals into di?erent components according to their scales. Classical examples of such decomposition include the Fourier decomposition and wavelet decomposition[20]. ……

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