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IDENTIFICATION OF THERMODYNAMIC PARAMETERS OF ARCTIC SNOW IN THE MULTI-DOMAIN COUPLED SYSTEM

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Abstract. This paper studies the multi-domain coupled distributed parameter system of temperature field and establishes identification model of the thermodynamic parameters (heat storage capacity, density, heat conductivity) of snow based on characteristics of temperature distribution of the snow, sea ice, water and the acquired data in the Arctic. According to the optimal control theory, the existence and the continuous dependability of the weak solution in terms of the parameters have been discussed. Furthermore, the optimal algorithm for the identification model is established. By using this optimal algorithm, the optimal parameters of Arctic snow are established and the numerical results of temperature distribution of Arctic snow, sea ice and water are demonstrated.

Keywords. The multi-domain coupled system; Parameter identification; Arctic ice; Distributed parameter; Optimal algorithm.

AMS (MOS) subject classification: 49J20, 35K90, 93B30, 68W99

1 Introduction

Sea ice is an essential part of Arctic circle and has an important influence on the global climate change. It forms a series of feedback mechanism in time and space domain, such as the albedo feedback of ice surface, the heat-insulation action of the sea ice, the liberative salinity of the sea ice freezing. And the desalination of sea water has an important influence on the global oceanic thermohaline circulation. Since weather and hydrologic condition in different sea fields are variable, the thermodynamic parameters in sea ice, sea water and snow are also different. In addition, the thermodynamic parameters of sea ice, sea water and snow play an important role in many fields, such as oil industry, seafaring, fishery etc. Because of the covering of snow, the solar shortwave radiation can not reach the sea ice, the temperature of Arctic snow has a great effect on the sea ice and water. Especially, the identification of parameters of snow is very important. Maykut [1] established the early thermodynamic sea ice model, which has been the basic model for advanced studies. Hibler [2] established the first dynamic and thermodynamic model