TOWARDS LINEAR INVERSE HEAT CONDUCTION PROBLEMS [1]

Dinh Nho Hào[2] **and H.-J. Reinhardt**
Universität-GH Siegen, Fachbereich Mathematik
57068 Siegen, Germany

Abstract

In many engineering contexts it is sometimes required to calculate the transfer surface heat flux, the surface temperature, and to determine the heat capacity, the heat transfer coefficient,... from a temperature history measured at fixed locations inside the body. These problems are well known under the name "inverse heat conduction problems" (IHCPs) and lead us mainly to consider the following noncharacteristic Cauchy problem for (linear and nonlinear) parabolic equations of the form

$$\begin{aligned} \mathcal{P}u(x,t) &= u_t(x,t),\ 0<x<1,\ 0<t\le T, \\ \text{"surface temperature"}|_{x=0} &= \varphi(t),\ 0<t\le T, \\ \text{"surface heat flux"}|_{x=0} &= g(t),\ 0<t\le T, \end{aligned} \tag{$*$}$$

where $\mathcal{P}$ is an elliptic operator, φ and g are given functions. We emphasize that *the initial condition at* $t=0$ *is not given!* These problems are well known to be *severely ill-posed* (see [5]). In this paper we shall give a survey of our recent results on these problems. For a further work, and a detailed analysis we refer to [1]-[8].

References

[1] Dinh Nho Hào: A noncharacteristic Cauchy problem for linear parabolic equations I: Solvability. *Math. Nachr.* (to appear).

[2] Dinh Nho Hào: A noncharacteristic Cauchy problem for linear parabolic equations II: A variational method. *Numer. Funct. Anal. and Optimiz.,* 13(5&6)(1992), 541-564.

[3] Dinh Nho Hào: A noncharacteristic Cauchy problem for linear parabolic equations and related inverse problems I: Solvability. *Inverse Problems* 10(1994), 295-315.

[4] Dinh Nho Hào: A noncharacteristic Cauchy problem for linear parabolic equations and related inverse problems II: A variational method. *Pitman Res. Notes, Math. Ser.* 263(1992), 43-56.

[5] Dinh Nho Hào and R. Gorenflo: A noncharacteristic Cauchy problems for the heat equation. *Acta. Appl. Math.* 24(1991), 1-27.

[1] In: E. Lipitakis (Ed.): Proceedings of the HERMIS-Conf. (Athens, 1994), 101–110. Hellenic Math. Soc., Athens, 1994.

[2] On leave from Hanoi Institute of Mathematics supported by the Deutsche Forschungsgemeinschaft (DFG).

[6] Dinh Nho Hào and H.-J. Reinhardt: Stable numerical solution to linear inverse heat conduction problems by the conjugate gradient method (submitted).

[7] H.-J. Reinhardt and Dinh Nho Hào: A Sequential Conjugate Gradient Method for the Stable Numerical Solution to Inverse Heat Conduction Problems (submitted).

[8] H.-J. Reinhardt and F. Seiffarth: On the approximate solution of illposed Cauchy problems for parabolic equations. In G. Anger *et al.* (Eds) *Inverse Problems: Principles and Applications in Geophysics, Technology and Medicine*. Akademie-Verlag, 1993, p. 284-298.