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SINGULAR ESTIMATES AND RICCATI THEORY FOR THERMOELASTIC PLATE MODELS WITH BOUNDARY THERMAL CONTROL

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Abstract. We consider an established thermoelastic plate model subject to boundary control in the thermal component. The model under investigation accounts for rotational forces, hence it is of predominantly hyperbolic type. Different sets of coupled (mechanical/thermal) boundary conditions are examined. It is shown that the quadratic optimal control problems associated with this system—over both finite and infinite time horizon—give rise to well-posed Riccati equations. In particular, it is proved that the gain operators are *bounded*. This type of result is rather unusual in the case of hyperbolic-like dynamics, where typically one obtains 'non-standard' Riccati equations with highly unbounded gain operators. What plays crucial role in the present analysis are specific regularity estimates obtained for the solutions to the thermoelastic problem, for each set of boundary conditions, which take advantage of the interactions between mechanical (hyperbolic) and thermal (parabolic) components of the dynamics. These regularity results allow to apply the Riccati theory recently developed for abstract control systems whose free dynamics operator A and control operator B yield singular estimates for the operator $e^{At}B$.

Keywords. Well-posedness of Riccati equations, boundary control, thermoelastic plates, singular estimates.
AMS (MOS) subject classification: 35B37, 49J20, 93C20.

1 Introduction

The present paper studies the quadratic optimal control problem and the related Riccati synthesis for thermoelastic systems with boundary controls. The model considered in the paper accounts for rotational forces, which fact is responsible for hyperbolic characteristics of the system.

The partial differential equations (PDEs) of linear thermoelastic plate equations on a bounded domain Ω of $\mathbb{R}^2$ are derived, e.g., in [9]. In general, a thermoelastic system consists of an elastic equation in the vertical displacement w and a heat equation in the relative temperature θ, which transfers mechanical and thermal energy through coupling. In the linear, homogeneous case, if one normalizes inessential constants and omits lower