

# Stability and Regularity Analysis for a Coupled Hyperbolic and Parabolic System

Zhuangyi Liu

Department of Mathematics and Statistics  
University of Minnesota Duluth, USA

Jianghao Hao

School of Mathematics  
Shanxi University, China

## Abstract

We consider a system of coupled hyperbolic and parabolic equations with initial value

$$\begin{cases} \frac{dU}{dt} = \mathcal{A}_{\alpha,\beta}U, \\ U(0) = U_0, \end{cases}$$

on a Hilbert space

$$\mathcal{H} = V \times H \times H,$$

where the operator  $\mathcal{A}_{\alpha,\beta}$  is defined by

$$\mathcal{A}_{\alpha,\beta} = \begin{pmatrix} 0 & I & 0 \\ -A & 0 & \gamma A^\alpha \\ 0 & -\gamma A^\alpha & -kA^\beta \end{pmatrix},$$

with the domain

$$D(\mathcal{A}_{\alpha,\beta}) = D(A) \times (D(A^\alpha) \cap D(A^{1/2})) \times (D(A^\beta) \cap D(A^\alpha)).$$

The above operator  $A$  is positive definite and self-adjoint.  $V = D(A^{\frac{1}{2}})$ , and  $H = L^2$ .  $\gamma$  and  $k$  are positive constants,

For the parameters  $\alpha, \beta \in [0, 1]$ , we shall investigate the following properties of the system,

1. the  $(\alpha, \beta)$  region for exponential stability and polynomial stability.
2. the  $(\alpha, \beta)$  region for analyticity and Gevery class.