张牧明

个人简历

华南师范大学数学科学学院
邮箱: zhangmm352@nenu.edu.cn
手机号码: 18004426855

个人信息

姓名: 张牧明　　性别: 女
年龄: 30　　籍贯: 黑龙江省齐齐哈尔市

教育背景

博士, 东北师范大学数学与统计学院, 应用数学, 2010.09–2016.12
毕业论文题目: 退化双曲方程的能控性和Ginzburg-Landau方程的不灵敏控制
导师: 高夯 教授 (博士导师) 柳絮 教授 (硕士导师)

学士, 东北师范大学数学与统计学院, 数学与应用数学, 2006.09–2010.07

工作经历

博士后, 华南师范大学数学科学学院, 2017.03–至今 (已完成出站答辩)
出站报告题目: 某些抛物型方程的控制问题
合作导师: 尹景学 教授 (杰青、"长江学者"特聘教授)

研究兴趣

分布参数系统控制理论: 退化偏微分方程、伪抛物方程、趋化模型的结构理论, 几何控制理论

应聘岗位

分布参数系统控制/随机系统控制: 讲师

主持项目

- 第63批中国博士后科学基金面上资助一等资助 (No.2018M630960), 8万元, 2018.05–2019.05. (同批次华南师范大学数学方向仅1人获资助)
- 华南师范大学青年教师科研培育基金 (No.17KJ01), 3万元, 2018.01–2019.01.

参加项目

- 国家自然科学基金面上项目: 爆破发展方程的控制理论 (No.11471070), 2015.01–2018.12, 参加人.
- 国家自然科学基金面上项目: 随机拟微分算子及其在控制论中的应用 (No.11371084), 2014.01–2017.12, 参加人.

已接收或发表的SCI论文

(1) **Muming Zhang**, Jingxue Yin, Hang Gao, *Insensitizing controls for the parabolic equations with dynamic boundary conditions*, **J. Math. Anal. Appl.**, 475(1)(2019),

861–873. (IF: 1.138)

(2) **Muming Zhang**, Tianyuan Xu, Jingxue Yin, *Controllability properties of degenerate pseudo-parabolic boundary control problems*, **Math. Control Relat. Fields**, accepted, DOI:10.3934/mcrf.2019034. (IF: 0.631)

(3) **Muming Zhang**, Hang Gao, *Interior controllability of semi-linear degenerate wave equations*, **J. Math. Anal. Appl.**, 457(1)(2018), 10–22. (IF: 1.138)

(4) Xiuxiang Zhou, **Muming Zhang** (通讯作者), *On the controllability of a class of degenerate parabolic equations with memory*, **J. Dyn. Control Syst.**, 24(4)(2018), 577–591. (IF: 0.693)

(5) **Muming Zhang**, Hang Gao, *Persistent regional null controllability of some degenerate wave equations*, **Math. Methods Appl. Sci.**, 40(16)(2017), 5821–5830. (IF: 1.18)

(6) **Muming Zhang**, Hang Gao, *Null controllability of some degenerate wave equations*, **J. Syst. Sci. Complex**, 30(5)(2017), 1027–1041. (IF: 0.53)

(7) **Muming Zhang**, Xu Liu, *Insensitizing controls for a class of nonlinear Ginzburg-Landau equations*, **Sci. China Math.**, 57(12)(2014), 2635–2648. (IF: 1.206)

已投稿论文

(1) Qiang Tao, **Muming Zhang** (通讯作者), *Trajectory controllability of singular parabolic-parabolic chemotaxis system.*

(2) Xiaoyu Fu, **Muming Zhang** (通讯作者), *Controllability of hyperbolic equations with mixed boundary conditions.*

参加学术活动

- 参加"2017年数学控制理论及应用学术研讨会", 作邀请报告: *Insensitizing controls for a class of parabolic equations with Ventcel boundary conditions*, 成都, 2017.11.
- 参加"2017年数学控制论及相关问题研讨会", 作邀请报告: *Exact controllability for the wave equation with Ventcel boundary conditions*, 重庆, 2017.11.
- 参加"第33届中国控制会议", 作邀请报告: *Insensitizing controls for some parabolic systems*, 南京, 2014.07.
- 参加"2014年青年教师数学控制理论及应用学术会议", 作邀请报告: *Controllability of one-dimensional degenerate hyperbolic equations*, 威海, 2014.07.
- 应张旭教授邀请到四川大学学术访问, 成都, 2015.07.20–2015.08.08.

教学经历

- 于2018年春季学期在华南师范大学讲授课程《高等数学II-2》. (学生评分: 96.217)
- 于2017年春季学期在华南师范大学担任《现代分析学》助教.

读研期间奖项

- 优秀研究生, 2014; 2015.
- 研究生学术活动先进个人, 2012; 2016.
- 研究生优秀奖学金, 2011; 2012; 2013; 2014.

附图

毕业及学位证书

博士毕业证书

博士研究生

毕 业 证 书

研究生 张牧明 性别 女 ，一九八八年 六月 一 日生，于二〇一三年 九 月至 二〇一六 年 十二 月在 应用数学 专业学习，学制 3 年，修完博士研究生培养计划规定的全部课程，成绩合格，毕业论文答辩通过，准予毕业。

校 长：

学 校：东北师范大学

二〇一六年十二月二十七日

东北师范大学制

No. 000354

编号：102001201601000354

博士学位证书

东北师范大学

博士学位证书

张牧明 ，女 ，1988 年 06 月 01 日生，在本校完成了 应用数学 学科（专业）博士学位培养计划。经东北师范大学学位评定委员会审定，授予其 理学 博士学位。

校 长

学位评定委员会主席

证书编号：1020022016100272

二〇一六年十二月二十七日

本科毕业证书

普通高等学校

毕 业 证 书

学生 张牧明 性别 女 ，一九八八 年 六 月 一 日生，于 二零零六 年 九 月至 二零一零 年 七 月在本校 数学与统计学院 数学与应用数学 专业 四 年制 本 科学习，修完教学计划规定的全部课程，成绩合格，准予毕业。

校 名：

校（院）长：

证书编号：102001201005001930

二零一零年 七 月 一 日

学士学位证书

学 士 学 位 证 书

张牧明 ，女，1988 年 06 月 01 日生。在 东北师范大学 数学与应用数学 专业完成了本科学习计划，业已毕业，经审核符合《中华人民共和国学位条例》的规定，授予 理学 学士学位。

东北师范大学

校 长

学位评定委员会主席

证书编号：1020042010P04618

二〇一〇年 七 月 一 日

（普通高等教育本科毕业生）

主持项目

博士后基金证书

中国博士后科学基金资助证书

Certificate of China Postdoctoral Science Foundation Grant

华南师范大学 博士后研究人员 张牧明

（全国博管办编号为 187808 ），获得第 63 批中国博士后科学基金面上资助 一 等资助，资助编号为 2018M630960 。

特颁此证。

中国博士后科学基金会

2018 年 05 月 04 日

证书查验请登录中国博士后科学基金会网站

华南师范大学青年教师科研培育基金

关于公布2017年华南师范大学青年教师科研培育基金项目资助名单的通知

[社科处 2018-01-04]

附件 1

2017 年华南师范大学青年教师科研培育基金项目（自然科学）资助名单

序号	项目批准号	项目名称	负责人	单位	经费（万元）
1	17KJ01	伪抛物型方程的能控性	张牧明	数学科学学院	3

其它

优秀研究生(1)

荣誉证书

张牧明 同学:

被评为2013-2014学年

优秀研究生

东北师范大学

2014年10月27日

优秀研究生 (2)

荣誉证书

张牧明 同学:

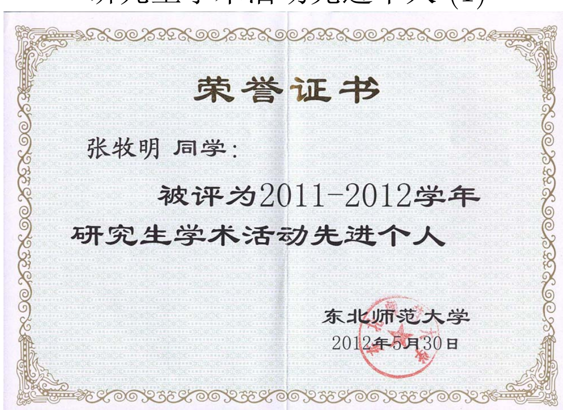
被评为 2014—2015 学年

优秀研究生

东北师范大学

2015 年 10 月 25 日

研究生学术活动先进个人 (1)



荣誉证书

张牧明 同学:

被评为2011-2012学年

研究生学术活动先进个人

东北师范大学

2012年5月30日

研究生学术活动先进个人(2)

荣誉证书

张牧明 同学:

被评为 2015—2016 学年

研究生学术活动先进个人

东北师范大学

2016 年 5 月 25 日

研究生优秀奖学金 (1)

荣誉证书

张牧明 同学:

被评为 2010 —2011 学年

研究生优秀奖学金

东北师范大学

2011 年 10 月 30 日

研究生优秀奖学金(2)

荣誉证书

张牧明 同学:

被评为 2011 —2012 学年

研究生优秀奖学金

东北师范大学

2012 年 10 月 30 日

研究生优秀奖学金 (3)

荣誉证书

张牧明 同学：

被评为 2012 —2013 学年

研究生优秀奖学金

东北师范大学

2013 年 10 月 30 日

研究生优秀奖学金(4)

荣誉证书

张牧明同学：

荣获2013 —2014学年

研究生优秀奖学金

东北师范大学

2014年10月27日

《高等数学II-2》任课记录

华南师范大学 教务管理系统

欢迎您： 张牧明老师 退出

返回首页 成绩录入 信息维护 信息查询 公用信息

当前位置 -- 教师个人课表查询

学年: 2017-2018 学期: 2 教学部门: 教师姓名(或工号) 查询教师 教师姓名: 张牧明

时间		星期一	星期二	星期三	星期四	星期五	星期六	星期日
早晨								
上午	第1节			高等数学（II-2） 必修 2节/周(1-18) 张牧明 2 - 301				
	第2节							
	第3节		高等数学（II-2） 必修 2节/周(1-18) 张牧明 2 - 301					
	第4节							

《高等数学II-2》教学质量评价

华南师范大学 教务管理系统

欢迎您： 张牧明老师 退出

返回首页 成绩录入 信息维护 信息查询 公用信息

当前位置 -- 教学质量评价

2017-2018 学年第 2 学期 高等数学（II-2） 教学质量 学生评价统计表

上课校区： 大学城校区

对教师评价分：96.217

参评学生人数：102　　有效参评学生人数：92　　对教师所有课程的加权平均分：96.217

评价号	评价指标	单项均值	满意度	权重	理论 / 实验	5(完全同意)100	4(基本同意)80	3(不表态) 60	2(基本不同意)40	1(完全不同意)20
20	我钦佩老师的工作态度和敬业精神	9.8478	97.64706%	0.10	理论	92	8	2		
21	体现现代教育理理念，用适当的教育手段和方法组织教学	9.7391	96.27451%	0.10	理论	85	15	2		
22	老师对课程的讲解清楚，语言准确	9.6087	94.90196%	0.10	理论	79	20	3		
23	教学信息量大，加深了我对教学内容的领悟	9.6304	95.09804%	0.10	理论	80	19	3		
24	课程内容尽可能联系了实践和应用	9.5217	94.11765%	0.10	理论	79	16	7		
25	讲课的进度、难度适当，重点突出	9.6304	95.4902%	0.10	理论	80	21	1		
26	能针对作业和实验存在的问题进行分析	9.6522	95.68627%	0.10	理论	82	18	2		
27	老师的课能激励和启发学生思维	9.5000	94.31373%	0.10	理论	74	27	1		
28	我学会了如何学习该课程的方法	9.5435	94.90196%	0.10	理论	78	22	2		
29	该课使我提高了解决相关问题的能力	9.5435	94.70588%	0.10	理论	76	25	1		

学生评语汇总：

1:老师在微信群里也很积极地为我们解决疑问，平时互动也很多，超棒！！！！！
2:老师讲课真的很棒！希望珍惜老师教书的时间
3:老师很耐心
4:老师好萌
5:建议老师在上课做习题时增加多一点我们独立思考的时间
6:很荣幸能够成为老师在华师带的唯一一届学生，老师很好很棒
7:很开心能选到小仙女的课，也很遗憾再也没有小仙女的课了。

1、单项均值为某项评价指标的有效评价分数的平均值。
2、满意度为某项评价指标的所有评价分数的平均值的百分比值。

J. Math. Anal. Appl. 475 (2019) 861–873

Contents lists available at ScienceDirect

Journal of Mathematical Analysis and Applications

www.elsevier.com/locate/jmaa

Insensitizing controls for the parabolic equations with dynamic boundary conditions ☆

Muming Zhang [a,*], Jingxue Yin [a], Hang Gao [b]

[a] School of Mathematical Sciences, South China Normal University, Guangzhou 510631, China
[b] School of Mathematics and Statistics, Northeast Normal University, Changchun 130024, China

ARTICLE INFO

Article history:
Received 4 February 2019
Available online 6 March 2019
Submitted by P. Yao

Keywords:
Parabolic equation
Insensitizing controls
Dynamic boundary conditions

ABSTRACT

This paper concerns with the insensitizing controllability property of the semilinear parabolic equation with dynamic boundary conditions. This problem can be reduced to a (relaxed) controllability problem for a coupled parabolic system with dynamic boundary conditions. An observability estimate for the corresponding coupled system with this type of boundary conditions is established, whose proof relies on a new global Carleman estimate.

1. Introduction and main results

It is well known that, there are three kinds of boundary conditions in PDEs, including Dirichlet boundary conditions, Neumann boundary conditions and Robin boundary conditions. PDEs with these kinds of boundary conditions and related control problems have been widely concerned and studied. Another kind of boundary conditions is called dynamic (or Ventcel) boundary conditions, which arises from numerous practical problems, for instance, a solid in contact with a thin layer of stirred liquid, the dynamic vibrations of linear viscoelastic rods, and beams with tip mass attached at their free ends (see [4,11,15]). For PDEs with this type of boundary conditions, the well-posedness and controllability problems have been investigated by many authors (see [7,6,9] and the rich references therein).

In this paper, we are interested in analyzing the insensitizing controllability property, which means the controls are robust to small unknown perturbations on the initial value. Consider the following parabolic equation subject to dynamic boundary conditions:

☆ This work is partially supported by the Natural Science Foundation of China under grants 11771156, 11371084, 11171060 and 11471070, by the China Postdoctoral Science Foundation under grant 2018M630960, and by the Fundamental Research Funds for the Central Universities under grant 2412015BJ011.

* Corresponding author.
E-mail addresses: zhangmm352@nenu.edu.cn (M. Zhang), yjx@scnu.edu.cn (J. Yin), hangg@nenu.edu.cn (H. Gao).

https://doi.org/10.1016/j.jmaa.2019.02.077

MATHEMATICAL CONTROL AND
RELATED FIELDS
doi:10.3934/mcrf.2019034

CONTROLLABILITY PROPERTIES OF DEGENERATE PSEUDO-PARABOLIC BOUNDARY CONTROL PROBLEMS

Mu-Ming Zhang, Tian-Yuan Xu* and Jing-Xue Yin

School of Mathematical Sciences, South China Normal University
Guangzhou 510631, China

(Communicated by Sorin Micu)

Abstract. This paper concerns with the boundary control of a degenerate pseudo-parabolic equation. Compare to the results those for degenerate parabolic equations, we discover that the null controllability property for the degenerate pseudo-parabolic equation is false, but the approximate controllability in some proper state space holds.

1. **Introduction and main results.**

Theoretical research of pseudo-parabolic equations was started due to their numerous physical applications, such as unidirectional propagation of long waves of small amplitude [1], capillary imbibition [9], and the well-known Benjamin-Bona-Mahony(BBM) equations [28, 29]. Mathematical study of pseudo-parabolic equations goes back to [22] in early 1970s, since then, linear and nonlinear pseudo-parabolic equations are investigated in the mathematical literatures for decades (see [2, 16] and so on).

Control issues for parabolic equations, including deterministic and stochastic parabolic equations, have received a lot of attention in the past few decades (see, for instance, [11],[12],[18],[19], [27] and the rich references therein). Pseudo-parabolic equations, as an important nonclassical parabolic equations, have been studied extensively on its control problems. The optimal control and the controllability property for this type of equations were first established in [25] and [26], respectively. Later in [15], the authors proposed the control laws that stabilize systems governed by the linear and the nonlinear pseudo-parabolic equations and illustrated the application of their results by numerical simulations. Further the internal controllability with the moving control for the pseudo-parabolic equations was considered in [23].

In the last decade, there are a large number of works attributed to the mathematical analysis of the degenerate pseudo-parabolic equations. Several topics on the degenerate pseudo-parabolic model such as traveling wave solutions and existence of weak solutions have been addressed, see [3, 20, 24] and other literatures. However,

2010 *Mathematics Subject Classification.* Primary: 93B05, 93B07; Secondary: 35K10.

Key words and phrases. Controllability, observability, degenerate pseudo-parabolic equation.

The first author is supported by the China Postdoctoral Science Foundation grant 2018M630960, and the Excellent Young Scholar Program of South China Normal University grant 17KJ01. The second author is supported by the Joint Training PhD Program of China Scholarship Council grant 201806750016, and the Innovation Project of Graduate School of South China Normal University grant 2018LKXM005. The third author is supported by NSFC grant 11771156.

* Corresponding author: Tianyuan Xu.

J. Math. Anal. Appl. 457 (2018) 10–22

Contents lists available at ScienceDirect

Journal of Mathematical Analysis and Applications

www.elsevier.com/locate/jmaa

Interior controllability of semi-linear degenerate wave equations ☆

Muming Zhang, Hang Gao *

School of Mathematics and Statistics, Northeast Normal University, Changchun 130024, China

ARTICLE INFO

Article history:
Received 24 January 2017
Available online 27 July 2017
Submitted by X. Zhang

Keywords:
Controllability
Observability
Unique continuation
Degenerate wave equation

ABSTRACT

In this paper, we prove the existence of interior controls for one-dimensional semi-linear degenerate wave equations. By using a duality argument, we reduce the problem to an observability estimate for the linear degenerate wave equation. First, the unique continuation for the degenerate wave equation is established. By means of this, and the multiplier method, we obtain the observability estimate.

1. Introduction and main result

Let us consider the following semi-linear degenerate wave equation:

$$\begin{cases} y_{tt} - (x^p y_x)_x + f(y) = \chi_\omega h & (x,t) \in Q, \\ y(0,t) = 0, \ y(s,t) = 0 & t \in (0,T), \\ y(x,0) = y_0(x), \ y_t(x,0) = y_1(x) & x \in \Omega, \end{cases} \tag{1.1}$$

with $h \in L^2(\omega \times (0,T))$ denoting the control, y denoting the state, (y_0, y_1) being an arbitrary initial value, and $f \in C^1(\mathbb{R})$ being a globally Lispchitz continuous function. In (1.1), $T > 0$, $s > 0$, $\Omega = (0,s)$ and $Q = \Omega \times (0,T)$. Let $0 < \alpha < \beta < s$ and $\omega = (\alpha, \beta)$ be a nonempty open subset of Ω. χ_ω denotes the characteristic function of ω. Take $p \in (0,1)$.

☆ This work is supported by the NSF of China under grants 11371084, 11471070 and 11171060, by the Fundamental Research Funds for the Central Universities under grants 14ZZ2222 and 2412015BJ011, by the National Basic Research Program of China (973 Program) under grant 2011CB808002, and by the Fok Ying Tong Education Foundation (China) under grant 141001.

* Corresponding author.
E-mail addresses: zhangmm352@nenu.edu.cn (M. Zhang), hanggao2013@126.com (H. Gao).

http://dx.doi.org/10.1016/j.jmaa.2017.07.057
0022-247X/© 2017 Published by Elsevier Inc.

J Dyn Control Syst
https://doi.org/10.1007/s10883-017-9382-7

On the Controllability of a Class of Degenerate Parabolic Equations with Memory

Xiuxiang Zhou[1] · **Muming Zhang**[2]

Received: 2 March 2017 / Revised: 8 August 2017

Abstract In this paper, we study the null controllability and approximate controllability for a class of weakly degenerate parabolic equations with memory by means of boundary controls. Unlike the known result for the degenerate parabolic equation, the degenerate parabolic equation with memory in general is not null controllable. This is based on the observability inequality for the adjoint system, which does not hold in the corresponding space. On the other hand, we prove the approximate controllability property of it in a suitable state space with a boundary control, which acts on the degenerate boundary or the nondegenerate boundary.

Keywords Degenerate parabolic equations with memory · Observability estimates · Approximate controllability · The degenerate boundary

Mathematics Subject Classification (2010) 93B05 · 35K05 · 35K65 · 93C20

1 Introduction

Let $T > 0$ and $Q := (0, 1) \times (0, T)$. For $\alpha \in (0, 1)$ and $a \in \mathbb{R} \setminus \{0\}$, we consider the following degenerate parabolic equation with memory:

$$\begin{cases} y_t - (x^\alpha y_x)_x = a\displaystyle\int_0^t y(x, s)\,\mathrm{d}s, & (x, t) \in Q, \\ y(0, t) = v_1(t), \ \ y(1, t) = v_2(t), & t \in (0, T), \\ y(x, 0) = y_0(x), & x \in (0, 1), \end{cases} \tag{1.1}$$

✉ Muming Zhang
zhangmm352@nenu.edu.cn

1 School of Mathematics and Computation Science, Lingnan Normal University, Zhanjiang, 524048, China

2 School of Mathematics and Statistics, Northeast Normal University, Changchun, 130024, China

Research Article

Mathematical Methods in the Applied Sciences

Received 25 January 2016 Published online 15 May 2017 in Wiley Online Library

(wileyonlinelibrary.com) DOI: 10.1002/mma.4431
MOS subject classification: 93B05; 35L80

Persistent regional null controllability of some degenerate wave equations

Muming Zhang and Hang Gao*†

Communicated by M. Brokate

This paper is addressed to a study of the persistent regional null controllability problems for one-dimensional linear degenerate wave equations through a distributed controller. Different from non-degenerate wave equations, the classical null controllability results do not hold for some degenerate wave equations. Thus, persistent regional null controllability is introduced, which means finding a control such that the corresponding state of the degenerate wave equation may vanish in a suitable subset of the space domain in a period of time. In order to solve this problem, we need to establish the regional null controllability for degenerate wave equations. This problem is reduced to a suitable observability problem of a linear degenerate wave equation. The key point is to choose a suitable multiplier in order to establish this observability inequality. Copyright © 2017 John Wiley & Sons, Ltd.

Keywords: persistent regional null controllability; observability; degenerate wave equation

1. Introduction and main result

Let $T' > T > 0, \Omega = (0,1)$ and $Q' = \Omega \times (0,T')$. Assume that

$$a \in C^1(\bar{\Omega}),\ a(0) = 0 \text{ and } a > 0 \text{ on } (0,1]. \tag{1}$$

Set $0 \le \alpha < \beta < 1$ and $\omega = (\alpha, \beta)$ be a given non-empty open subset of Ω. Denote by χ_ω the characteristic function of the set ω.

Consider the following linear degenerate wave equation with a distributed controller:

$$\begin{cases} y_{tt} - (a(x)y_x)_x + c(x,t)y = \chi_\omega h & (x,t) \in Q', \\ (ay_x)(0,t) = 0,\ y(1,t) = 0 & t \in (0,T'), \\ y(x,0) = y_0(x),\ y_t(x,0) = y_1(x) & x \in \Omega, \end{cases} \tag{2}$$

where $h \in L^2(\omega \times (0,T'))$ is the control variable, y is the state variable, (y_0, y_1) is any given initial value, and $c \in L^\infty(Q')$.

We first introduce a linear space $H_a^1(\Omega)$:

$$H_a^1(\Omega) = \left\{ u \in L^2(\Omega) \,\middle|\, u \text{ is locally absolutely continuous in } (0,1],\ \sqrt{a}u_x \in L^2(\Omega) \text{ and } u(1) = 0 \right\}.$$

Then $H_a^1(\Omega)$ is a Hilbert space with the inner product

$$(u,v)_{H_a^1(\Omega)} = \int_\Omega (uv + au_xv_x)dx, \quad \forall\, u,v \in H_a^1(\Omega).$$

Also, $H_a^*(\Omega)$ denotes the conjugate space of $H_a^1(\Omega)$ and

$$|v|_{H_a^*(\Omega)} = \sup_{|u|_{H_a^1(\Omega)}=1} \langle u,v \rangle_{H_a^1(\Omega),H_a^*(\Omega)}.$$

School of Mathematics and Statistics, Northeast Normal University, Changchun 130024, China
* Correspondence to: Hang Gao, School of Mathematics and Statistics, Northeast Normal University, Changchun 130024, China.
† E-mail: hanggao2013@126.com

J Syst Sci Complex (2017) 30: 1027–1041

Null Controllability of Some Degenerate Wave Equations*

ZHANG Muming · GAO Hang

DOI: 10.1007/s11424-016-5281-3
Received: 23 November 2015 / Revised: 23 February 2016

Abstract This paper is devoted to a study of the null controllability problems for one-dimensional linear degenerate wave equations through a boundary controller. First, the well-posedness of linear degenerate wave equations is discussed. Then the null controllability of some degenerate wave equations is established, when a control acts on the non-degenerate boundary. Different from the known controllability results in the case that a control acts on the degenerate boundary, any initial value in state space is controllable in this case. Also, an explicit expression for the controllability time is given. Furthermore, a counterexample on the controllability is given for some other degenerate wave equations.

Keywords Controllability, degenerate wave equation, Fourier expansion, observability.

1 Introduction and Main Results

Let $T > 0$, $L > 0$ and $\alpha > 0$. Set $Q = (0, L) \times (0, T)$. Consider the following linear degenerate wave equation with a boundary controller:

$$\begin{cases} w_{tt} - (x^\alpha w_x)_x = 0, & (x,t) \in Q, \\ \begin{cases} w(0,t) = 0, & (0 < \alpha < 1) \\ (x^\alpha w_x)(0,t) = 0, & (\alpha \geq 1) \end{cases} & t \in (0,T), \\ w(L,t) = \theta(t), & t \in (0,T), \\ w(x,0) = w_0(x), \ w_t(x,0) = w_1(x), & x \in (0,L), \end{cases} \tag{1}$$

ZHANG Muming · GAO Hang (Corresponding author)
School of Mathematics and Statistics, Northeast Normal University, Changchun 130024, *China.*
Email: zhangmm352@nenu.edu.cn; hanggao2013@126.com.
*This research was supported by the National Natural Science Foundation of China under Grant Nos. 11371084, 11471070 and 11171060, by the Fundamental Research Funds for the Central Universities under Grant Nos. 14ZZ2222 and 2412015BJ011, by the National Basic Research Program of China (973 Program) under Grant No. 2011CB808002, and by the Fok Ying Tong Education Foundation under Grant No. 141001.
◇ *This paper was recommended for publication by Editor SUN Jian.*

SCIENCE CHINA
Mathematics

• ARTICLES •

December 2014 Vol. 57 No. 12: 2635–2648
doi: 10.1007/s11425-014-4837-8

Insensitizing controls for a class of nonlinear Ginzburg-Landau equations

ZHANG MuMing & LIU Xu*

School of Mathematics and Statistics, Northeast Normal University, Changchun 130024*, China*
Email: zhangmm352@nenu.edu.cn, liuxu@amss.ac.cn

Received June 3, 2013; accepted January 10, 2014; published online June 30, 2014

Abstract This paper shows the existence of insensitizing controls for a class of nonlinear complex Ginzburg-Landau equations with homogeneous Dirichlet boundary conditions and arbitrarily located internal controller. When the nonlinearity in the equation satisfies a suitable superlinear growth condition at infinity, the existence of insensitizing controls for the corresponding semilinear Ginzburg-Landau equation is proved. Meanwhile, if the nonlinearity in the equation is only a smooth function without any additional growth condition, a local result on insensitizing controls is obtained. As usual, the problem of insensitizing controls is transformed into a suitable controllability problem for a coupled system governed by a semilinear complex Ginzburg-Landau equation and a linear one through one control. The key is to establish an observability inequality for a coupled linear Ginzburg-Landau system with one observer.

Keywords insensitizing controls, controllability, Ginzburg-Landau equation

MSC(2010) 93B05, 93B07

Citation: Zhang M M, Liu X. Insensitizing controls for a class of nonlinear Ginzburg-Landau equations. Sci China Math, 2014, 57: 2635–2648, doi: 10.1007/s11425-014-4837-8

1 Introduction and main results

Let $n \in \mathbb{N}\backslash\{0\}$ and $T > 0$. Assume that $\Omega \subset \mathbb{R}^n$ is a bounded domain with a C^2 boundary Γ. Set $Q = \Omega \times (0,T)$ and $\Sigma = \Gamma \times (0,T)$. Let ω and $\mathcal{O}$ be two given nonempty open subsets of Ω, and denote by χ_ω the characteristic function of the set ω. Unless otherwise stated, we assume that the functions mentioned in this paper are complex-valued.

Consider the following controlled nonlinear complex Ginzburg-Landau equation:

$$\begin{cases} y_t - (1+\mathrm{i}a)\Delta y + by + f(|y|^2)y = \chi_\omega u + \xi, & \text{in } Q, \\ y = 0, & \text{on } \Sigma, \\ y(0) = y_0 + \tau \widehat{y}_0, & \text{in } \Omega, \end{cases} \tag{1.1}$$

where u is the control variable, y is the state variable, i denotes the imaginary unit, a is any given real number, $b \in L^\infty(0,T;W^{1,\infty}(\Omega))$ is any given function, ξ and y_0 are two known functions, τ is an unknown small real number, $\widehat{y}_0$ is an unknown function, and $f : \mathbb{R} \to \mathbb{R}$ is a given real-valued C^2 function with $f(0) = 0$.

*Corresponding author