List of RGJ advisors 2023/2024

Name:	Assistant Professor Sawanya Sakuntasathien, Ph.D.		
Program:	Mathematics, Doctoral program	**Department:**	Mathematics
Faculty:	Science	**University:**	Silpakorn University
Telephone:	034-147-020 and 034-147-021 087-675-5552	**Email:**	sakuntasathien_s@su.ac.th

Keywords: Solution. Evolution Equation. Hyperbolic Equation. Source. Damp.

Summary of research: As in the attached document.

Sawanya Sakuntasathien

July 2023

Date of Birth: September 14, 1977

Nationality: Thai

Education:

B.Sc. (Mathematics)	1998	Mahidol University, Bangkok, Thailand
M.Sc. (Mathematics)	2001	Chulalongkorn University, Bangkok, Thailand
Ph.D. (Mathematics)	2008	University of Nebraska-Lincoln, Lincoln, Nebraska

Professional Experience:

Assistant Professor	2018-present	Silpakorn University, Nakhonpathom, Thailand
Lecturer/Researcher	2008-2018	Silpakorn University, Nakhonpathom, Thailand
Teaching/Research Assistant	2004-2008	University of Nebraska-Lincoln

Research Interests: Partial differential equations and analysis, broadcast dominations in graphs.

Grants, Contracts, Fellowships:

1. Development and Promotion of Science and Technology Talents Project Scholarship (Thailand) 1996-2001
2. The scholarship granted by the Ministry of Science (Thailand), 2002-2007
3. Regents Tuition Fellowship, UNL, 2002-2003
4. Grad Nonresident Fellowship, UNL, 2002-2007
5. The Emeritus Faculty Fellowship, Mathematics Department, UNL, 2005-2006
6. Honorable Mention, Folsom Distinguished Award, UNL, February 2009 for 2008
7. Research Grant by Faculty of Science, Silpakorn Universtiy, 2010
8. Research Grant in Development of Learning Achievement by Faculty of Science, Silpakorn University, 2014

Courses Taught at University of Nebraska-Lincoln:

Year	*Fall*	*Spring*	*Summer*
2005-2006	Math 107(Recitations)		
2006-2007	Math 107(Recitations)	Math 101	Math 101
2007-2008	Math 106(Recitations)	Math 107(Recitations)	

Undergraduate Courses Graded (as a grader) at University of Nebraska-Lincoln:

Year	*Fall*	*Spring*	*Summer*
2005-2006		Math 398	

Graduate Courses Graded (as a grader) at University of Nebraska-Lincoln:

Year	*Fall*	*Spring*	*Summer*
2004-2005	Math 921	Math 922	
2006-2007	Math 924		

Courses Taught at Silpakorn University, Thailand:

Year	
2008-present	511101 (Calculus I)
	511101/511104 (Calculus I Recitations)
	511104 (Calculus for engineers I)
	511105 (Calculus for engineers II)
	511102/511105 (Calculus II and Calculus for engineers II Recitations)
	511321 Partial Differential Equations
	519321 (Introduction to Mathematical Analysis (for Applied Mathematic))
	511512 (Partial Differential Equations, graduate)
	511431 (Elementary Topology)
	511412 (Partial Differential Equations, undergraduate)
	511421/321 (Partial Differential Equations, undergraduate)
	511421 (Mathematical Analysis)
	511432 (Elementary Topology)
	511491 (Research Project)
	511631 (Topology, graduate)
	511544 (Real Analysis, graduate)
	511549 (Functional Analysis, graduate)
	511561 (Mathematical Exploration by numerical software)
	511561 (Theory of Ordinary differential Equations)
	511791/792/793 (Seminar in Advanced Mathematics I-III)

Service Activities:

University of Nebraska-Lincoln Departmental:

1. Served on registration for American Mathematical Society Fall 2005 Central Section Meeting at UNL (October 2005).
2. Served on Analysis Qualifying Exam Workshop (summer 2006).
3. Served on registration for Nebraska Conference for Undergraduate Woman in Mathematics at UNL (February 2007 and 2008).
1. *University of Nebraska-Lincoln Campus:*
2. Treasurer of Thai Association of University of Nebraska-Lincoln (May 2002-August 2004).
3. Secretary of Thai Association of University of Nebraska-Lincoln (July 2005- July 2006).
4. *Thai National:*
5. Served on Round I Thai Regional Mathematical Olympiad Examination committee (August 2008).
6. Served on Thai Mathematical Competition bestowed by HRH Crown Princess Maha Chakri Sirithorn committee (2008, 2009, 2010, 2011).
7. Served on training camp for Thai Regional Mathematical Olympiad Examination committee
8. (2008- present).
4. Served on being a deputy team leader of Silpakorn University for The 11th Thai Mathematical Olympiad (2014)
5. Served on being a problem captain for The 12th Thai Mathematical Olympiad (2015)
6. Served on being a coordinator for The 56th International Mathematical Olympiad (2015)
7. Served on being a team leader of Silpakorn University for The 13th Thai Mathematical Olympiad
9. (2016)
8. Served on being a lecturer for Silpakorn Young Scientist Summer School, Silpakorn University (2016)
9. Served on being a lecturer for Silpakorn Young Scientist Summer School, Silpakorn University (2023)
10. Served on the chair of Geometer Sketchpad Competition for งานศิลปหัตถกรรม (2022)

Other Professional Meetings Attended:

1. American Mathematical Society Fall 2005 Central Section meeting at UNL (October 2005)
2. Nebraska Conference for Undergraduate Woman in Mathematics at UNL (February 2007 and 2008).
3. International Conference of Algebras and Related Topics (Thailand, May 2008)
4. Thai Mathematical Olympiad on Geometry and Combinatorics Lecture for Lecturer (September 2009)
5. Franco-Thai in Pure and Applied Mathematics at Mahidol University (Thailand, October 2009)

6. Professor Raimo Nakki seminar at Silpakorn University (Thailand, January 2010)
7. Workshops in Geometric and Singular Analysis, Potsdam University (Germany 2014)
8. The 27th Annual Meeting in Mathematics 2023 (Thailand, May-June 2023)

Publications:

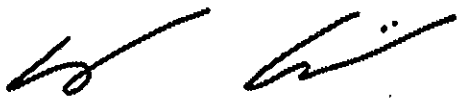
1. Global well-posedness of systems of nonlinear wave equations with degenerate damping and source terms, (with Prof. Mohammad A. Rammaha), *Nonlinear Analysis,* 72 (2010), 2658–2683.
2. Critically and degenerately damped systems of nonlinear wave equations with source terms, (with Prof. Mohammad A. Rammaha), *Applicable Analysis,* 89(8) (2010), 1201–1227.
3. Hadamard Well-posedness for a Hyperbolic Equation of Viscoelasticity with Supercritical Sources and Damping, (with Y. Guo, M. A. Rammaha, E. S. Titi, and D. Toundykov), *Journal of Differential Equations* 257(2014), 3778-3812.
4. Blow-up of a Hyperbolic Equations of Viscoelasticity with Supercritical Nonlinearities, (with Y. Guo, M. A. Rammaha), 263(3)(2017), 1956-1979.
5. Dominating Broadcasts in Fuzzy Graphs, (with P. Noppakaew and K. Hengthonglert), *Mathemetics*, 10(2) (2022) 281, https://doi.org/10.3390/math10020281.

Thai Publications:

1. Some Nonabsolutely Convergent Lebesgue Type Integrals, Master Thesis, Chulalongkorn University, 2001.

Thai Proceedings:

1. ผลการจัดกิจกรรมการเรียนรู้โดยใช้กระบวนการคิดสร้างสรรค์ที่มีต่อผลสัมฤทธิ์ทางการเรียนและความคิดสร้างสรรค์เรื่องพื้นที่ผิวและปริมาตรของนักเรียนชั้นมัธยมศึกษาปีที่ 3. (with Wantana Polapak). *The 27th AMM2023 Proceedings,* (2023), 223-235.



(Assistant Professor Dr. Sawanya Sakuntasathien)

การกรอกรายละเอียดในแบบฟอร์มนี้ ต้องดำเนินการให้ครบถ้วนตามความเป็นจริง หากตรวจสอบพบว่ามีการปกปิดหรือเป็นเท็จ วช. ขอสงวนสิทธิ์ที่จะไม่พิจารณาสนับสนุนและจะเป็นผู้ไม่มีสิทธิ์รับทุน วช. เป็นเวลา ๓ ปี

แบบเสนอโครงการวิจัย (Research Project)
ประกอบการเสนอขอทุนอุดหนุนการวิจัยของสำนักงานการวิจัยแห่งชาติ (วช.)
โครงการปริญญาเอกกาญจนาภิเษก (คปก.) ภายใต้ความร่วมมือไตรภาคีไทย-สวีเดน
ประจำปีงบประมาณ ๒๕๖๗

๑. ชื่อโครงการวิจัย บนสมการวิวัฒนาการที่มีการหน่วงและแหล่งต้นทางไม่เชิงเส้น

On the Evolution Equation with Nonlinear Damping and Source.

๒. ชื่อ-สกุล อาจารย์ที่ปรึกษา

ผู้ช่วยศาสตราจารย์ ดร.สวรรยา ศกุนตะเสถียร

สาขาวิชาคณิตศาสตร์ ภาควิชาคณิตศาสตร์ คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร

Subject of Mathematics, Department of Mathematics, Faculty of Science, Silpakorn University

สถานที่อยู่ที่ติดต่อได้สะดวก พร้อมหมายเลขโทรศัพท์ โทรศัพท์มือถือ โทรสาร และไปรษณีย์อิเลคทรอนิกส์

ภาควิชาคณิตศาสตร์ คณะวิทยาศาสตร์ มหาวิทยาลัยศิลปากร วิทยาเขตพระราชวังสนามจันทร์

6 ถนนราชมรรคาใน ตำบลพระปฐมเจดีย์ อำเภอเมือง ฯ จังหวัดนครปฐม 73000

เบอร์โทรศัพท์ 034-147-020 และ 034-147-021

เบอร์โทรศัพท์มือถือ 087-675-5552

Assistant Professor Sawanya Sakuntasathien, Ph.D.

Email address: sakuntasathien_s@su.ac.th

Address: Department of Mathematics, Faculty of Science, Silpakorn University

Sanamchandara Palace Campus,

6 Ratchamankanai Rd., Prapathomchedi, Amphor Mueng, Nakhonpathom, Thailand 73000

Tel: 034-147-020 and 034-147-021

Mobile Number: 087-675-5552

Email address: sakuntasathien_s@su.ac.th

๓. กลุ่มสาขาวิทยาศาสตร์พื้นฐานที่สมัคร (เลือกเพียง ๑ กลุ่ม)

☐ ชีววิทยา (Biology) ☐ เคมี (Chemistry)

☐ ฟิสิกส์ (Physics) ☑ คณิตศาสตร์ (Mathematics)

๔. **ผู้ใช้ประโยชน์ (Research stakeholders)** (กรณีมีความร่วมมือฯ) เช่น ความร่วมมือของหน่วยงานภาครัฐ (เช่น กระทรวง กรม)/เอกชนที่ร่วมสนับสนุนทุนวิจัย เช่น MOU เป็นต้น

☐ มี.....*(โปรดระบุชื่อความร่วมมือ และหน่วยงาน)*.....

☑ ไม่มี

๕. **คำสำคัญ (Keyword) ของโครงการ** Solution. Evolution Equation. Hyperbolic Equation. Source. Damp.

๖. **ความสำคัญและที่มาของปัญหาที่ทำการวิจัย (Problem statement and significance of research)**

ตามเอกสารแนบ As in the attached document.

๗. **ทฤษฎี/สมมุติฐานของโครงการ (Hypothesis)**

ตามเอกสารแนบ As in the attached document.

๘. **วัตถุประสงค์ของโครงการ (Objectives)**

The present goal of this paper is at least one of the followings:

1. the existence of a solution of the equation in the form of (1.1) under some conditions on the operator L and its parameter, damping, or source terms along with the initial data. Our study is inspired by the advances in [4-11] and the consequent developments.
2. Investigate the blow-up result of the solution of equation in the form of (1.1) but with the generalized damping motivated by [5,9].

๙. **การทบทวนวรรณกรรม/ผลงานวิจัยที่เกี่ยวข้อง (Literature Review)**

ตามเอกสารแนบ As in the attached document.

๑๐. **ระเบียบวิธีวิจัย (Methodology)**

1. Study various evolution equations and hyperbolic equations of similar forms from previous research work.
2. Study relevant information such as related principles in analysis and partial differential equations.
3. Determine a solution of the equation in the form of (1.1) and/or investigate the blow-up solution of the equation in the form of (1.1).
4. Complete the project.
5. Review and revise the project.

๑๑. ขอบเขตของการวิจัย (Scope of the study)

We study the evolution equation (1.1) as shown in the attached document topic 1.1 The Model under some conditions on the parameter, operator, damping, and/or source terms which will be identified during the study of the work.

๑๒. ผลผลิต (Output) ผลลัพธ์ (Outcome) และ ผลกระทบ (Impact) ที่คาดว่าจะได้จากการวิจัย

We expect the existence of a solution and/or blow-up of the solution of the equation in the form of (1.1) as shown in the attached document under some conditions on the parameter, operator, damping, and/or source terms which will occur during the investigation.

The impact expected from the study is the broader views for the analysis of the evolution equation with nonlinear damping and source terms. Since this type of equation arose from some physical problems, the prediction of the consequent events from the problems could be more precise.

1. Introduction and Literature Overview

1.1. The model. Let $\Omega \subset \mathbb{R}^n$ be a bounded domain, open and connected, with a smooth boundary Γ, where $n = 1, 2, 3$. In this manuscript, we are interested in studying the following model under some conditions of the damping and source term:

$$\begin{cases} u_{tt} - \eta Lu + g(u_t) = f(u), & \text{in } \Omega \times (0,T), \\ u(x,t) = 0, & \text{on } \Gamma \times (0,T), \\ u(x,0) = 0, & \text{in } \Omega, \\ u_t(x,0) = 0, & \text{in } \Omega, \end{cases} \tag{1.1}$$

where the unknown u is an $\mathbb{R}$-valued function on $\Omega \times (0,T)$ along with the initial and boundary conditions of Dirichlet type, and the parameter η is approaching to zero. The operator L, here, represents an elliptic operator defined as $Lu = \sum_{i,j=1}^{n} \frac{\partial}{\partial x_i}\left(a_{ij}(x)\frac{\partial u}{\partial x_j}\right)$. The interior source $f(u)$ and the damping term $g(s)$ presented here is nonlinear. This equation illustrates the interaction between damping and source terms.

1.2. Motivation and Literature Overview. A hyperbolic equation is a type of evolution equations that describe wave-like phenomena and propagation. These equations exhibit unique behavior compared to other types of partial differential equations. They play a crucial role in understanding and modeling such phenomena across diverse fields of science and engineering. They provide insights into how disturbances and information propagate through different mediums and systems. The basic model of the wave equations [4] is the linear homogeneous equation $u_{tt} - c^2\Delta u = 0$, where c is the speed of propagation, and $u := u(x,t)$ is the displacement over the variables x in a domain $\Omega \subset \mathbb{R}^n$ and the time variable t. The notation Δ is the usual Laplacian in the Euclidean space. Hyperbolic equations are usually accompanied by specific initial and boundary conditions that help determine a unique solution to the problem. If there are the interior linear force acting to the system, the equation becomes the nonhomogeneous equation $u_{tt} - \Delta u = f(x,t)$. When the resistance, so-called damping term, presents, the equation is in the form $u_{tt} - \Delta u + g(u_t) = f(x,t)$.

In quantum field theory (referred in [7, 10]), the evolution equations of the following nonlinear type has been studied, ,

$$u_{tt} - \Delta u + \mathcal{R}(x,t,u,u_t) = \mathcal{F}(x,u), \tag{1.2}$$

where $\mathcal{R}$ and $\mathcal{F}$ meet the structural requirements $vR(x,t,u,v) \geq 0$, $\mathcal{R}(x,t,u,0) = \mathcal{F}(x,0) = 0$, and $\mathcal{F}(x,u) \sim |u|^{p-1}u$ for large $|u|$. Begin with the work of Reed [12] in 1976, he proposed the problem in the form of (1.2) but without any damping. The nonlinear source term $|u|^{p-1}u$ drives the solution blows up in finite time. On the other hand, the presence of damping term only yields the global existence of a solution of the equation (see [1, 3]). In 1994, Georgiev and Todorova [6] studied the following

problem;

$$\begin{cases} u_{tt} - \Delta u + a|u_t|^{m-1}u = b|u|^{p-1}u, & \text{in } \Omega \times (0,\infty), \\ u(x,t) = 0, & \text{on } \Gamma \times \mathbb{R}, \\ u(x,0) = u_0, & \text{in } \Omega. \end{cases}$$

In the investigation, the interaction of the damping $a|u|^{m-1}u$ and the source $b|u|^{p-1}u$ makes the problem quite difficult and more interesting. As well as for the coupled equations analyzed in [2, 7, 11] and for the recent work in [13, 14], the existence and uniqueness of global and local solutions has been valid when the exponent of the damped term is subordinate. Furthermore, weak solutions for the systems blow up in finite time under the negativity of the initial energy and the superiority of the exponent of the source terms.

In 2021, Nachid and Gozo [9] investigated the numerical solution of the following problem

$$\begin{cases} u_{tt} - \xi Lu + b|u_t|^q = f(u), & \text{in } \Omega \times (0,\infty), \\ u(x,t) = 0, & \text{on } \Gamma \times \mathbb{R}, \\ u(x,0) = 0, & \text{in } \Omega, \\ u_t(x,0) = 0, & \text{in } \Omega. \end{cases} \tag{1.3}$$

They studied problem (1.3) under the condition that the source $f(s)$ is positive, increasing, and convex for the nonnegative values of s, $\int_0^\infty \frac{ds}{f(s)} < \infty$, and the parameter ξ and b are positive. The result shows that the solution of the equation (1.3) blows up in finite time provided that the initial data and the parameter ξ are small. This work scheme was motivated by the research of Friedman and Lacey [5]. They described the blow-up of the solution of the heat equation

$$\begin{cases} u_t - \epsilon\Delta u = f(u), & \text{in } \Omega \times (0,T), \\ u(x,t) = 0, & \text{on } \Gamma \times \mathbb{R}, \\ u(x,0) = u_0(x), & \text{in } \Omega, \end{cases} \tag{1.4}$$

under some conditions on the initial data.

To the knowledge presently, there are no works dealing with problem (1.1). The present goal of this paper is at least one of the followings:

- Analyze the existence of a solution of the equation of the form (1.1) under some conditions on the operator L and its parameter, damping, or source terms along with the initial data. Our study is inspired by the advances in [4, 5, 6, 7, 8, 9, 10, 11] and the consequent developments.
- Investigate the blow-up result of the solution of the equation of the form (1.1) but wtih the generalized damping motivated by [5, 9].

References

[1] K. M. Agre and M. Rammaha. Global solutions to boundary value problems for a nonlinear wave equation in high space dimensions. *Differential and Integral Equations*, 2001.

[2] K. M. Agre and M. Rammaha. Systems of nonlinear wave equations with damping and source terms. *Differential Integral Equations*, 19(11):1235–1270, 2006.

[3] D. D. Ang and A. Pham Ngoc Dinh. Mixed problem for some semi-linear wave equation with a nonhomogeneous condition. *Nonlinear Analysis: Theory, Methods & Applications*, 12(6):581–592, 1988.

[4] L. C. Evans. *Partial Differential Equations*, volume 19 of *Graduate studies in mathematics*. American Mathematical Society, 2010.

[5] A. Friedman and A. A. Lacey. The blow-up time for solutions of nonlinear heat equations with small diffusion. *Siam Journal on Mathematical Analysis*, 18(3):711–721, 1987.

[6] V. Georgiev and G. Todorova. Existence of a solution of the wave equation with nonlinear damping and source terms. *Journal of Differential Equations*, 109(2):295–308, 1994.

[7] Y. Guo and M. A. Rammaha. Systems of nonlinear wave equations with damping and supercritical boundary and interior sources. *Transactions of the American Mathematical Society*, 366(5):2265–2325, 2014.

[8] Y. Guo, M. A. Rammaha, S. Sakuntasathien, E. S. Titi, and D. Toundykov. Hadamard well-posedness for a hyperbolic equation of viscoelasticity with supercritical sources and damping. *Journal of Differential Equations*, 257(10):3778–3812, 2014.

[9] H. Nachid, Y. Gozo, et al. The decay estimate and asymptotic behaviour of the blow up time for evolution equation with a non linear source. *Journal of Ramanujan Society of Mathematics & Mathematical Sciences*, 8(2), 2021.

[10] D. R. Pitts and M. A. Rammaha. Global existence and non-existence theorems for nonlinear wave equations. *Indiana University Mathematics Journal*, 51(6):1479–1509, 2002.

[11] M. A. Rammaha and S. Sakuntasathien. Global existence and blow up of solutions to systems of nonlinear wave equations with degenerate damping and source terms. *Nonlinear Analysis: Theory, Methods Applications*, 72(5):2658–2683, 2010.

[12] M. C. Reed. *Abstract non linear wave equations*, volume 507. Springer-Verlag, 1976.

[13] E. Vitillaro. On the wave equation with hyperbolic dynamical boundary conditions, interior and boundary damping and supercritical sources. *Journal of Differential Equations*, 265(10):4873–4941, 2018.

[14] Y. Ye and L. Li. Global solutions and blow-up for a class of strongly damped wave equations systems. *Frontiers of Mathematics*, 17(5):767–782, 2022.

(Assistant Professor Dr. Sawanya Sakuntasathien)
Applicant name