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*Editors*

## **UP Baguio Sab-atan 2021 Conference Proceedings**

**November 24-26, 2021**

**Baguio City, Philippines**



# UP Baguio 2021 Conference Proceedings

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**About the cover:** Designed by UP Baguio Fine Arts faculty Ms. Ides Josepina D. Macapanpan, the foreground shows a dap-ay with a stylized Cordillera weave in the background. The dap-ay is an important indigenous socio-political structure for the northern Kankana-ey people of Mt. Province. It is a meeting place, a sab-atan, where important affairs of the community are discussed and resolved. The Cordillera weave symbolizes the interconnection and interleaving of diverse knowledge systems.

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## Preface

As it celebrates its 60<sup>th</sup> Anniversary of establishment in the Northern region of the archipelago, University of the Philippines Baguio (UP Baguio) has stepped up to another level as the Department of Mathematics and Computer Science of the College of Science launches its very first international mathematics conference on November 24 -26, 2021 via virtual platform.

The event is named “Sab-atan 2021: International Conference on Mathematical Sciences and Applications.” Details can be seen in <https://sites.google.com/up.edu.ph/sab-atan2021/home> .

*Sab-atan* is a new word to many, even for most of the organizers, but its magnificence equally depicts the purpose of the event. It is a Kankana-ey word that means a place for meeting or gathering. The event is then envisioned to be Sab-atan, a point of convergence of new results and knowledge that will be shared by mathematicians from all over the world. It is also a converging point to build friendships, and academic and research linkages.

This year’s conference is in honor of Dr. Priscilla S. Macansantos (Ma’am Precy), a highly respected woman mathematician in the region and in the Philippines, and the first chancellor of UP Baguio. She contributed a lot, especially in steering the university’s directions, as far as teaching and research are concerned, and with the help of her successors UP Baguio now is one of the leading institutions of higher learning in the country. She’s an instrument in the promising growth of the academic programs of the department.

The conference is also dedicated to Dr. Teofina Rapanut, Prof. Reynaldo Rimando, Prof. Avelino Bucaoto, and to all former colleagues and professors who inspired and motivated the faculty to dream big, chase their dreams, and act accordingly and wholeheartedly.

The plenary speakers come from 4 countries, including the Philippines. They are: Dr. Rolando de Santiago (Purdue University, USA), Dr. Mohd Hafiz Mohd (Universiti Sains Malaysia), Dr. Marian Roque (UP Diliman), Dr. Ricardo del Rosario (Broad Institute of MIT and Harvard, USA), Dr. Editha Jose (UP Los Baños), Prof. Dr. Hideyuki Azegami (Nagoya University, Japan), Dr. Dennis Bacani (Temple University-Japan Campus) and our honoree.

The opening plenary lecture was delivered by Dr. de Santiago. His talk was about *Classification of von Neumann algebras –  $L_2$  cohomology and  $s$ -malleable deformations maximal rigid subalgebras*. In the study he shared, he investigated which structural aspects of the group extend to the resulting von Neumann algebra. He was followed by Dr. Mohd, who shared a research entitled *On the Dynamics of Multi-Species Communities with Biotic Interactions and Dispersal Process*. In the co-authored paper, they employed mathematical models to examine the joint effects of biotic interactions and dispersal processes on multi-species community dynamics

across heterogeneous environments. The techniques from dynamical systems and bifurcation analysis are used to investigate the overall dynamical behaviors of the ecological systems. The last speaker on that day was Dr. Roque, who showcased her collaborative research on *Automated Construction of a Phylogenetic Tree of Languages Using a Feature-Sensitive Metric*. In her talk, she presented around 200 common words from chosen Philippine Languages and shared how each word was expressed as a vector representing the presence or absence of phonetic features.

On the second day, Dr. del Rosario provided a tour of some of their research projects where they used computational biology to analyze genomic data, and how the results could answer biological questions. His talk is entitled *Computational biology: applications to tuberculosis and genetic analysis of marmosets*. On one hand, with the title *Power of Power Laws: Modeling Biochemical Reaction Systems*, Dr. Jose discussed the mathematical properties of power law kinetic systems which are directly related to the key properties of the chemical reaction networks that induce them. In the afternoon, with a talk on *PDE constrained shape optimization problems and their real-world applications*, Dr. Azegami shared to us shape optimization and topology optimization problems and discussed some numerical results. The participants were fascinated when real world applications were illustrated.

During the last day, Dr. D. Bacani, former student of honoree, discussed the *Solvability of singular nonlinear partial differential equations with arbitrary order*. He was joined by Dr. Macansantos who talked about *Fixed Point Theorems in Applications, including Differential Equations and Inclusions*. Our honoree presented and compared various fixed point theorems in various spaces, and talked about recent developments and generalizations.

In this year's Sab-atan, 14 countries are represented, including the Philippines, coming from 31 local schools and universities and 20 foreign universities. The 176 registered participants (35 are paper presenters) come from Austria, Japan, India, Latvia, Lithuania, Malaysia, Morocco, Portugal, Spain, Thailand, Turkey and Philippines; and the foreign plenary speakers come from Japan, Malaysia and USA.

Sab-atan 2021 focuses on Analysis (the area of expertise of Ma'am Precy) and its applications. Five (5) parallel tracks distributed in 3 parallel sessions were identified, namely, Optimization and Control, Algorithms, Functional Analysis, Mathematical Modelling and Numerical Analysis.

Thirty-five abstracts were accepted for presentation in the conference. These were compiled in the Book of Abstracts that was given to all participants. For some reason, only seven (7) were able to submit full papers for the promised proceedings. The papers went through a rigorous review process, and four (4) papers made it to the completion stage.

It was indeed a successful online conference. Kudos to all who contributed, in one way or another, to the success of Sab-atan 2021. We thank the speakers, presenters, participants, guests, distinguished UP and UPB officials, sponsors (MSP National, and CAR-Regions 1, 2 Chapter), video contributors, and graphics artist. A big congratulations to the Sab-atan organizing team, including the tech staff, RAs and TAs, and the very energetic emcee.

We would also like to express our hearty thanks to Matimyás Matematika for agreeing to publish the conference proceedings.

We hope that more papers will be published in future conference proceedings coming from the proposed recurring Sab-atan.

**Issue Editor-in-Chief**

Jerico B. Bacani

**Associate Editors**

Wilfredo V. Alangui

Priscilla S. Macansantos

Mohd Hafiz Mohd

## The Editorial Board

**DR. JERICO BRAVO BACANI** holds the positions of Professor of Mathematics and Head of the Graduate Program Office at the University of the Philippines Baguio. He has a notable background, having previously served as Chairman of the Department of Mathematics and Computer Science at the College of Science for 9 years. He currently serves as President of the Mathematical Society of the Philippines – CAR, Regions 1, and 2 Chapter, and is a member of various professional organizations, including International Society of Difference Equations (ISDE), National Research Council of the Philippines (NRCP), and Philippine American Academy of Scientists and Engineers (PAASE). He obtained his MS and BS degrees in Mathematics from the University of the Philippines through CHED and DOST scholarship programs, respectively. He also holds a Doktor rerum naturalium (Mathematik) degree from Karl-Franzens-Universität Graz, which he earned through the support of Austria's Eurasia-Pacific-Uninet Technology Grants.

Prof. Bacani does research in Analysis and Number Theory. He has published several papers in refereed international and national mathematics journals and proceedings, and most of which have received international publication awards from UP System. His passion for mathematics has earned him various accolades, including the *Best Paper in Mathematics Award* at the 2013 International Conference in Mathematics and Computing, the *UPB Chancellor Award for Outstanding Senior Faculty* in 2014, and the 2016 *CSC Presidential Lingkod Bayan Award (Regional Winner)*. Additionally, he has received the *One UP Professorial Chair awards* for 3 consecutive periods (2016-2018, 2019-2021, 2022-2024), and he has held the prestigious *UP Scientist* title since 2017.

**DR. WILFREDO VIDAL ALANGUI** is an indigenous person from northern Philippines, a *Kankana-ey-Ilocano*, and Professor of Mathematics of the Department of Mathematics and Computer Science in the College of Science, UP Baguio. His research interest is on the interplay of mathematics and culture, encompassing disciplines like philosophy, anthropology, sociology, history and ecology. He joined the academic staff in 1986.

As a mathematician and mathematics educator, Prof. Alangui's teaching, research, public, and extension work are largely informed and dictated by an interdisciplinary and critical perspective arising from his academic training and his being as an indigenous person and activist.

**DR. PRISCILLA SUPNET MACANSANTOS** obtained her BS degree in Mathematics, *magna cum laude* from UP Baguio, and her MS and PhD degrees, also in Mathematics, from the University of Delaware in the USA. While working for her doctoral degree she was on a Fulbright Graduate Fellowship. Her field of interest is Mathematical Analysis, with Differential Equations and Inclusions as applied areas. In the 1998 to 2003, she was Associate member of the Third World Academy of Sciences (TWAS); in 2000, she was an Exchange scientist at the Osaka Prefecture University, through a grant from the Japan Society for the Promotion of Science (JSPS). In 2012 and 2015, she was Visiting Research Fellow at Vanderbilt University Medical Center. Prof. Macansantos has presented papers in local and international conferences. She continues to teach graduate Mathematics courses at UP Baguio. She has published several papers in international and local journals, has been given International Publication Awards by UP, and has also been recipient of several Professorial Chair awards. She served as Chancellor of UP Baguio from 2003 to 2012. Dr. Macansantos was recently conferred the title of Professor Emeritus by UP's Board of Regents.

**DR. MOHD HAFIZ MOHD** is an Associate Professor at the School of Mathematical Sciences, Universiti Sains Malaysia. His research interests are Mathematical Biology, Mathematical Modeling, and Stochastic Agent-based Modeling.

Prof. Mohd joined the School of Mathematical Sciences, Universiti Sains Malaysia, as a Senior Lecturer in 2016. He is a researcher working in the field of Mathematical Modelling. His research uses continuation and simulation methods to improve our predictions of species geographic distributions in nature. He is also interested in modelling the problems in engineering and other biological systems such as epidemiology and ecology. To address these problems, he employs deterministic models and stochastic individual-based models. He uses the techniques from differential equations, dynamical systems, numerical continuation and stochastic processes to develop mathematical and computational tools to answer a range of biologically inspired questions.

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Parallel Session Presenters

Conference Proceedings Contributors

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Research Assistants and Teaching Assistants

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Matimyás Matematika

Partners for Indigenous Knowledge Philippines

Dap-ayan ti Kultura iti Kordilyera

Salidummay

Tinig Amianan

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