

Regional Program
Scientific Cooperation

STIC – AmSud

Final Report

Deadline : March 31st, 2025

Project Title:	5G & B5G Technology based on artificial intelligence for Underground Vehicles Communications with OWC/RF (B5Go)
Investigation Area:	Visible Light Communications, Digital Signal Processing, Optical Wireless Networks, AI
Starting year:	2023

1 Participants

1.1 International Coordinator

Name:	Ismael Soto
Country:	Chile
Institution:	Universidad de Santiago de Chile
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1.2 Scientific Coordinators:

	Institution	**Name of the National Coordinator**	**E mail**
French Partner A	Université de Lorraine	Patrick Charpentier	patrick.charpentier@univ-lorraine.fr
South American Partner A	Universidad Santiago de Chile	Ismael Soto	ismael.soto@usach.cl
South American Partner B	Universidad de Chile	Cesar Azurdia	cazurdia@ing.uchile.cl
South American Partner C	Universidad Católica del Maule	David Zabala	dzabala@ucm.cl
South American Partner D	Universidad Tecnológica Empresarial de Guayaquil	Diego Carrera	dfcarrera@outlook.com

1.3. List of the investigators involved in the project:

Name	**Institution**	**Status** (Senior, post-doctoral investigator, PhD student)
Christian Fernandez-Campuzano	Usach	Senior Investigator
Nicolas Krommenacker	Lorriane University	Senior Investigator
Sandy Bolufe	Usach	Post-doctoral fondecyt, Investigator
Raul Zamorano-Illanes	Northumbria University	PhD student
Roberto Ahumada	UCM	PhD student
Cristobal Carreño Mosqueira	Lorriane University	PhD student
Gonzalo Maureira	UChile	MSc student

1.4. Number of senior investigators involved in the project: 2

1.5. Number of post-doctoral students involved in the project: 1

1.6. Number of PhD students involved in the project: 3

2 Funds

2.1. Funds from funding agencies (in euros):

Funding Agencies	**2023**		**2024**	
	Funds received	**Funds spent**	**Funds received**	**Funds spent**
MINCYT or SICYT (Argentina)				
UMSA (Bolivia)				
CAPES (Brazil)				
MINCIENCIAS (Colombia)				
CONCYTEC (Peru)				
ANID (Chile)	4.950	4.950	5.021	5.021
CMM (Chile)				
CONACYT (Paraguay)				
ANII (Uruguay)				
INRIA (France)				
IMT (France)				
MEAE (France)	1800	1800	1800	1800
CNRS (France)	2200	2200	1800	1800
MPPEUCT (Venezuela)				
SENESCYT (Ecuador)	0	0	0	0
TOTAL:	8950	8950	8621	8621

2.2. Total of funds spent (in euros): 17.571

2.3. Number of missions[1]: 8

[1] One mission is one round trip

2.4. Detailed *missions* expenses:

A) Senior investigators' missions:

Investigator (name, institution, status)	**Mission details** Objective: Place: Date: Duration:	**Travelling Costs**	**Travel Allowance**	**TOTAL (euros)**
Cesar Azurdia Meza, University of Chile, Coordinator	Objective: *Opportunities for IoT through Optical Wireless Communications* Place: Quito, Ecuador Date: 2024/10/20 - 2024/10/23 Duration: 3 days	386.858,00	120.000,00	506.858,00
David Zabala, Catholic University of Maule, Coordinator	Objective: *Using Artificial Neural Networks for Hard Biometric Person Recognition and Classification* Place: Quito, Ecuador Date: 2024/10/20 - 2024/10/24 Duration: 4 days	392.857,00	160.000,00	553.875,00
Christian Fernandez Campusano, University of Santiago, Investigator	Objective: 1) *Based Detection of Aleurothrixus Floccosus in Citrus Crops Ecological Technology* and 2) *Boosting Federated Learning for Optimization LTE-RSRP Networks.* Place: Quito, Ecuador Date: 2024/10/20 - 2024/10/27 Duration: 7 days	404.091,00	120.000,00	524.091,00

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Investigator (name, institution, status)	**Mission details** Objective: Place: Date: Duration:	**Travelling Costs**	**Travel Allowance**	**TOTAL (euros)**
Ismael Soto Gómez, University of Santiago, Coordinator	Objective: *VLC/Satellite 5G* Place: Quito, Ecuador Date: 2024/10/20 - 2024/10/27 Duration: 7 days	442.350,00	2.324.945,00	2.767.295,00
Ismael Soto Gómez, University of Santiago, Coordinator	Objective: *AI-Augmented VLC Systems with Digital Twin Capabilities* Place: Talca, Maule Region Date: 4-7 December 2024 Duration: 3 days	0	200.000,00	200.000,00

Additionally, Professors Nicolas Krommenacker and Patrick Carpentier traveled to Santiago, Chile, to deliver a conference on scholarship opportunities for master's degree exchange programs for the 2025-2026 period at the CNRA/CRAN laboratory, linked to the field of telecommunications and telematics, on October 30, 2024, at 11:30 a.m. in the auditorium of the Electrical Engineering Department at USACH, broadcast live.

B) Students' missions (Post-doctoral position, PhD student...):

Students (name, institution, status)	**Mission details** Objective: Place: Date: Duration:	**Travelling Costs**	**Travel Allowance**	**TOTAL (euros)**
Gonzalo Maureira, University of Chile, MSc Student	Objective: *Implementation of a 5G Standalone Open RAN Architecture for Private Networks* Location: Quito, Ecuador Dates: 2024/10/20 - 2024/10/27 Duration: 7 days	459.349	120.000	579.349
(5.130.450,00 a 1022.00 Euro/CL$ aprox.) TOTAL (euros) :				5.021,00

3 Scientific Evaluation

3.1 Short Description of the Main Scientific Results of the Project

The STIC-AmSud-supported project has achieved remarkable progress in visible light communication (VLC), machine learning (ML), and wireless network technologies from 2023 to 2025, as demonstrated by 109 peer-reviewed publications. This initiative has seamlessly integrated scientific rigor with practical solutions, tackling real-world challenges faced by industry partners—such as demand-driven ventilation for enhanced energy efficiency and safety—while cultivating a vibrant, interdisciplinary research ecosystem. These efforts have not only driven technological innovation but also set the stage for impactful future collaborations aimed at advancing applied solutions across diverse fields. To contextualize these achievements, the project addressed critical problems outlined in the video Opportunity, focusing on innovative VLC systems for applications like IoT-based patient monitoring in hospitals, sustainable farming under varying atmospheric conditions, and underground mining communications through hybrid VLC/RF and non-line-of-sight (NLOS) approaches. Advanced ML techniques, including Extreme Learning Machines (ELM) and neural networks, have been pivotal in optimizing fingerprint classification, detecting epileptic seizures via EEG, and predicting cardiovascular diseases in challenging environments like tunnels. Furthermore, the project has enhanced 5G and mmWave network optimization, developed energy-efficient traffic prediction models, and pioneered collision warning systems by integrating ML with decentralized sensing, thereby contributing to smart agriculture, vehicular safety, and industrial automation. These findings, disseminated through high-impact journals and conferences, highlight the project's transformative role in interdisciplinary technological innovation, with a particular emphasis on demand-driven ventilation solutions.

3.2 Project Website (Optional)

For a comprehensive overview of the project's advancements, including detailed results that enable demand-driven ventilation to improve the quality of life for people inside tunnels, as well as multimedia content, visit the official project website; additionally, the video Findings offers valuable insights into the key outcomes and innovations achieved throughout the initiative.

3.3 List of Publications Related to the Project

(The publications should mention the STIC-AmSud program. Please include the publications as an active link in the form or send them as .PDF):

1. **Road Incident Detection under Rate Adaptation-Based Congestion Control in Cooperative Vehicular Systems**
   S Bolufé, JF Silva, CA Azurdia-Meza, I Soto, S Céspedes.
   IEEE Access, 2024.
   https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10634164

2. **Hybrid Digital Twin Model for Greenhouse and Underground Environments**
   PP Játiva, I Soto, CA Azurdia-Meza, I Sánchez, R Wang, W Kern.

IEEE Access (5 citations), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10534064

3. **Precoding for RIS-Assisted Multi-User MIMO-DQSM Transmission Systems**
FR Castillo-Soria, JA Del Puerto-Flores, CA Azurdia-Meza, et al.
Future Internet, 15(9):299 (5 citations), 2023.
https://www.mdpi.com/1999-5903/15/9/299

4. **A Novel Traffic Prediction Method Using Machine Learning for Energy Efficiency in Service Provider Networks**
F Rau, I Soto, D Zabala-Blanco, C Azurdia-Meza, M Ijaz, S Ekpo, et al.
Sensors, 23(11):4997 (12 citations), 2023.
https://www.mdpi.com/1424-8220/23/11/4997

5. **A New COVID-19 Detection Method Based on CSK/QAM Visible Light Communication and Machine Learning**
I Soto, R Zamorano-Illanes, R Becerra, PP Játiva, CA Azurdia-Meza, et al.
Sensors, 23(3):1533 (7 citations), 2023.
https://www.mdpi.com/1424-8220/23/3/1533

6. **A Wavelength-Dependent Visible Light Communication Channel Model for Underground Environments and Its Performance Using a Color-Shift Keying Modulation Scheme**
R Becerra, CA Azurdia-Meza, P Palacios Játiva, I Soto, J Sandoval, M Ijaz, et al.
Electronics, 12(3):577 (7 citations), 2023.
https://www.mdpi.com/2079-9292/12/3/577

3.4 List of Participations in Seminars and Congresses Related to the Project

The following papers were presented at various conferences, with the one highlighted in yellow being selected as the Best Paper of the conference.

1. **On the Performance on 100 kbps Short-Range Wireless Optical Communication Using Visible Light**
D Zabala-Blanco, CA Azurdia-Meza, A Mascaró-Muñoz, N Aravena, I Soto, et al.
2024 IEEE Latin-American Conference on Communications (LATINCOM), pp. 1–6, 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10770690

2. **Design and Implementation of a Low-Cost VLC Photovoltaic Panel-Based Receiver**
A González-Uriarte, C Azurdia, D Torreblanca, P Palacios-Játiva, et al.
2024 IEEE Latin-American Conference on Communications (LATINCOM), pp. 1–6, 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10770662

3. **On the Performance of Image Transmission in an Indoor Visible Light Communication System**

G González, PP Játiva, CA Azurdia-Meza, D Zabala-Blanco, MG Gaitán, et al.
2024 IEEE Latin-American Conference on Communications (LATINCOM), pp. 1–6, 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10770657

4. **Pulse Shaped SC-FDMA MIMO Systems with Reduced PAPR**
S Kamal, CA Azurdia-Meza, C Estevez
2024 IEEE Latin-American Conference on Communications (LATINCOM), pp. 1–6 (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10770664

5. **On the Performance of an Air-Water Visible Light Communication System**
G Martínez, PP Játiva, MG Gaitán, CA Meza, N Boettcher, et al.
International Conference on Advanced Research in Technologies, Information and Communication, 2024.
https://doi.org/10.1007/978-3-031-83432-5_27

6. **IoT Application Development: A Comprehensive Narrowband Connectivity Device Solution**
M Moreno, A Núñez, J Sandoval, CA Azurdia-Meza, E Carrasco, et al.
International Conference on Advanced Research in Technologies, Information and Communication, 2024.
https://doi.org/10.1007/978-3-031-83432-5_25

7. **LSTM-Based Head-on Collision Warning System with a Decentralized Radio Sensing Approach**
JD Cárdenas, O Contreras-Ponce, CA Gutiérrez, R Aguilar-Ponce, et al.
2024 IEEE 100th Vehicular Technology Conference (VTC2024-Fall), pp. 1–5, 2024.

8. **Detection and Classification of Cardiovascular Diseases Using Neural Networks**
BE Zamorano, AD Firoozabadi, A Brutti, P Adasme, D Zabala-Blanco, et al.
2024 Signal Processing: Algorithms, Architectures, Arrangements, and Applications (SPA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10715609

9. **NB-IoT Path Loss Experimental Measurements in Urban Outdoor Environments**
M Moreno, D Oxman, J Sandoval, CA Azurdia-Meza, MG Gaitán, et al.
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636491

10. **Enhancing Green Underground VLC Channels with Polar Codes and Multiresolution Analysis**
J Pereira, I Soto, P Adasme, G Gatica, P Palacios, C Azurdia, et al.
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636430

11. **Analysis of a Visible Light Positioning Database in Extreme Learning Machines Applications**
BL Soto, CA Azurdia-Meza, D Zabala-Blanco, I Soto, PP Játiva, et al.
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636616

12. **Performance Analysis of a VLC System Applied to a Hospital Environment for IoT-Based Smart Patient Monitoring**
B Fernández, PP Játiva, CA Azurdia-Meza, N Boettcher, D Zabala-Blanco, et al.
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (2 citations), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636464

13. **Aquila Optimizer for Hyperparameter Metaheuristic Optimization in ELM**
P Vasquez-Iglesias, D Zabala-Blanco, AE Pizarro, J Fuentes-Concha, et al.
Iberoamerican Congress on Pattern Recognition, pp. 244–258, 2024.
https://doi.org/10.1007/978-3-031-76604-6_18

14. **A Review on Predicting Bee Honey Production Using Machine Learning**
R Ahumada-García, IM Adasme, D Zabala-Blanco, XA López-Cortés, et al.
2024 43rd International Conference of the Chilean Computer Science Society (SCCC), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10767605

15. **Hyper-Parameter Optimization of Regularized-Extreme Learning Machine Using a Modified Opposition-Based Learning**
P Vasquez-Iglesias, AE Pizarro, D Zabala-Blanco, J Fuentes-Concha, et al.
2024 43rd International Conference of the Chilean Computer Science Society (SCCC), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10767651

16. **Diamond Prices Estimation with ELM-Based Regressors**
D Zabala-Blanco, J Ramírez, R Ahumada-García, M Flores-Calero, et al.
2024 43rd International Conference of the Chilean Computer Science Society (SCCC), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10767650

17. **Human Face Orientation Based on MobileNetV2 Architecture-Enhanced Convolutional Neural Network**
M Flores-Calero, N Betancourt, N Jacho-Guanoluisa, A Albuja, et al.
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766764

18. **MRA-Based Digital Filter Using Daubechies 12 and Deep Learning for Exoplanet Light Curves**
E Toledo-Mercado, I Soto
2024 43rd International Conference of the Chilean Computer Science Society (SCCC),

2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10767624

19. **Real-Time Anomaly Detection Algorithm for DoS Attacks in Communication Networks with IEDs Using IEC 61850**
T Castillo, I Soto, H Chávez
International Conference on Advanced Research in Technologies, Information and Communication, 2024.
https://doi.org/10.1007/978-3-031-83432-5_26

20. **Frequency Event Identification by a LSTM Network Approach**
LG Pincheira, H Chavez, I Soto, J Quiroz
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766769

21. **Optimizing Coverage and Energy in Underground Wireless Networks**
I Galeas-Cutiño, ME Zamora, I Soto
International Conference on Advanced Research in Technologies, Information and Communication, 2024.
https://doi.org/10.1007/978-3-031-83432-5_23

22. **Adaptive MRA Digital Filter Using Wavelet, and NARX Neural Network for Ground-Based Transmission Spectroscopy**
E Toledo-Mercado, I Soto
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766763

23. **Automated Biological Analysis System: Integration of Chatbots and Edge Computing**
F Reveco-Toledo, I Soto, V García
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766799

24. **Exploring Worst Arc Flow Minimization: A Comparative Study of a Provided Wireless Network**
P Adasme, A Viveros, I Soto, AD Firoozabadi, DZ Rodríguez
International Conference on Mobile Web and Intelligent Information Systems (MobiWIS), 2024.
https://doi.org/10.1007/978-3-031-68005-2_5

25. **Experimental Proof-of-Concept Design of Self-Power LiFi Communication System for IoT Applications**
F Vladuceanu, M Ijaz, S Ekpo, B Adebisi, I Soto, PP Játiva, S Ghafoor
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636573

26. **Impact of the CMOS Pixel Clock on Optical Camera Communication Using Rolling Shutter Mode**
R Zamorano-Illanes, Z Ghassemlooy, O Younus, X Li, S Zvánovec, I Soto, et al.
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636659

27. **Neural Network-Based Stress Detection in Crop Multispectral Imagery for Precision Agriculture**
L Reyes-Hung, I Soto, AK Majumdar
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636659

28. **Hybrid Model for Estimating State of Charge of Lithium-Ion Batteries**
C Fernandez-Grandon, W Alavia, I Soto
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636680

29. **Optimal Design and Coverage for 5G Networks Operating in the mmWave Frequency Spectrum**
S Cordero, P Adasme, H Kaschel, I Soto
2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP) (1 citation), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10636626

30. **Drone and Computer Vision-Based Detection of Aleurothrixus Floccosus in Citrus Crops**
B Vergara, K Toledo, C Fernández-Campusano, AR Santamaria
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766459

31. **Boosting Federated Learning for Optimization LTE-RSRP Networks**
A Acuña-Avila, H Kaschel, ME Zamora, CG Fernandez, et al.
2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA), 2024.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10766776

32. **Speaker Counting by Scattered Microphone Array Based on DOA and Eigenvalue Estimations**
AD Firoozabadi, P Adasme, D Zabala-Blanco, P Palacios-Játiva, et al.
2023 9th International Conference on Signal Processing and Communication (ICSC), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10441322

33. **Detection of Epileptic Seizures by Analysis of Electroencephalogram Based on Wavelet Transform**
SU Fredes, AD Firoozabadi, P Adasme, D Zabala-Blanco, PP Játiva, et al.

2023 9th International Conference on Signal Processing and Communication (ICSC), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10441343

34. **Performance Evaluation of Link Adaptation Algorithms in 5G NR**
A González, D Torreblanca, JI Sandoval, M Marín, C Azurdia
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418696

35. **On the Path Loss Performance of Underwater Visible Light Communication Schemes Evaluated**
L Almonacid, PP Játiva, CA Azurdia-Meza, D Dujovne, I Soto, et al.
2023 South American Conference On Visible Light Communications (SACVLC), pp. 12–16 (2 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347786

36. **Recovery Strategy for Building a Resilient VLP System**
C. Carreño, N. Krommenacker, P. Charpentier.
In *2023 South American Conference On Visible Light Communications (SACVLC)*, pp. 70–75, 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347755

37. **Crop Stress Detection with Multispectral Imaging Using IA**
L Reyes-Hung, I Soto, R Zamorano-Illanes, P Adasme, M Ijaz, C Azurdia, et al.
2023 South American Conference On Visible Light Communications (SACVLC), pp. 59–64 (3 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347583

38. **Optimization of Visible Light Positioning in Industrial Applications Using Machine Learning**
Y Alkandari, M Ijaz, S Ekpo, B Adebisi, I Soto, R Zamorano-Illanes, et al.
2023 South American Conference on Visible Light Communications (SACVLC), pp. 141–146 (2 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347641

39. **Know Your Vulnerable Neighbors: Awareness Model for 5G C-V2X Communications Mode 2**
A Yáñez, S Céspedes, C Azurdia-Meza
Proceedings of the Int'l ACM Symposium on Design and Analysis of Intelligent Vehicular Networks and Applications (DIVANet'23), 2023.
https://dl.acm.org/doi/10.1145/3616392.3623416

40. **Wine Quality Classification Using Physicochemical Properties Along with Extreme Learning Machines**
ÍT González, D Zabala-Blanco, R Ahumada-García, JPR Malcó, et al.
2023 42nd IEEE International Conference of the Chilean Computer Science Society (SCCC), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10315749

41. **Extreme Learning Machines as Equalizers on Optical OFDM Systems**
A Mascaró-Muñoz, R Ahumada-García, D Zabala-Blanco, et al.
2023 IEEE Colombian Conference on Applications of Computational Intelligence (ColCACI), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10226069

42. **Detection of Obfuscated Malware by Engineering Memory Functions Applying ELM**
LI Moraga, JPR Malcó, D Zabala-Blanco, R Ahumada-García, et al.
2023 IEEE Colombian Conference on Applications of Computational Intelligence (ColCACI) (3 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10226058

43. **Experimental Indoor Coverage of a Commercial mm-Wave 5G Network**
JE Arévalo, AE Núñez, CA Azurdia, JL Araque, JI Sandoval
2023 IEEE USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), pp. 13–14 (4 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10289282

44. **Multi-Task Extreme Learning Machine for Palm Vein Multiclassification**
A Mascaró-Muñoz, D Zabala-Blanco, R Hernández-García, et al.
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418734

45. **Development of an Aviat Antenna Calibration Device to Improve Communications Efficiency**
LBI Moraga, JPR Malcó, D Zabala-Blanco, R Ahumada-García
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418723

46. **Extreme Learning Machines for Predicting the Diamond Price Range**
J Ramírez, D Zabala-Blanco, R Ahumada-García, JPR Malcó, et al.
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON) (2 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418771

47. **Extreme Learning Machine for Iris-Based Diabetes Detection**
C Fernandez-Grandon, I Soto, D Zabala-Blanco
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON) (2 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418742

48. **On the Performance of MIMO-VLC Techniques in Underground Mining Environments**
J Solis, PP Játiva, CAA Meza, D Zabala-Blanco, C Gutiérrez, S Kamal, et al.
2023 IEEE Latin-American Conference on Communications (LATINCOM), pp. 1–6, 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10361869

49. **Automation of Counting and Analysis of Biological Samples through Computer Vision and Telecom Technologies**
F Reveco, I Soto, R Zamorano-Illanes, V Garcia, W Kern, D Zabala-Blanco, ehttps://ieeexplore-ieee-org.ezproxy.usach.cl/document/10361869t al.
2023 South American Conference On Visible Light Communications (SACVLC), pp. 147–152 (1 citation), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347591

50. **Experimental Study of Visible Light Communication Links with a Strong Line of Sight Component**
CF Utreras, VF Ávalos, PP Játiva, CA Meza, I Soto, D Zabala-Blanco
2023 South American Conference On Visible Light Communications (SACVLC), pp. 106–111 (3 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347545

51. **Multi-Channel Target Speech Enhancement Using Labeled Random Finite Sets and Deep Learning**
J Datta, AD Firoozabadi, D Zabala-Blanco, FRC Soria, M Adams, C Perez
2023 IEEE 5th Eurasia Conference on IOT, Communication and Engineering (1 citation), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10382971

52. **Extreme Learning Machine (ELM) for Detection of Hazardous Near Earth Objects**
R Ahumada-García, EM Faúndez, D Zabala-Blanco, XA López-Cortés, et al.
2023 42nd IEEE International Conference of the Chilean Computer Science Society (SCCC), 2023https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10382971.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10315739

53. **Extreme Learning Machines for Detecting the Water Quality for Human Consumption**
PB Valdebenito, D Zabala-Blanco, R Ahumada-García, I Soto, et al.
2023 IEEE Colombian Conference on Applications of Computational Intelligence (ColCACI), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10225820

54. **Evaluation of Extreme Learning Machines for Detecting Heart Diseases**
D Martínez, D Zabala-Blanco, R Ahumada-Garcia, I Soto, AD Firoozabadi, et al.
2023 IEEE Colombian Conference on Applications of Computational Intelligence (ColCACI), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10226128

55. **Minimizing the Worst Arc Flow Localizing Switch and Controller-Type Nodes in a Software-Defined Network**
A Viveros, P Adasme, I Soto
2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10418769

56. **Machine Learning in Spectral Imaging for Smart Farming: A Review**
L Reyes-Hung, I Soto

2023 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON) (2 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10418639

57. **Target Detection in ISAC System Equipped with IRS: A Joint Active and Passive Beamforming Approach**
S Awad, R Wang, I Soto
International Conference on Communications and Networking in China, pp. 66–80, 2023.
https://doi.org/10.1007/978-3-031-67162-3_5

58. **Satellite-Based Urban Tree Cover Estimation System for Smart City Applications** https://doi.org/10.1007/978-3-031-67162-3_5
L Figueroa-García, I Soto, R Zamorano-Illanes, P Adasme, P Palacios, et al.
2023 South American Conference On Visible Light Communications (SACVLC), pp. 53–58, 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347541

59. **A Comparative Analysis of 5G Digital Twin Microservices with FSO Integration for Underground Mining**
J Munoz-Saez, I Soto, R Zamorano-Illanes, D Fuentealba, W Kern, et al.
2023 South American Conference On Visible Light Communications (SACVLC), pp. 82–87 (3 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347734

60. **A Multiple Linear Regression Approach to Optimize the Worst User Capacity and Power Allocation**
P Adasme, A Viveros, MS Ayub, I Soto, AD Firoozabadi, DZ Rodríguez
2023 South American Conference On Visible Light Communications (SACVLC), pp. 6–11 (3 citations), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347689

61. **Assessing Breast Cancer Risk with 5G-Enabled Data-Sensorized Sample Using Random Forest**
I Galeas-Cutiño, I Soto, R Zamorano-Illanes, P Adasme, S Gutierrez
2023 South American Conference On Visible Light Communications (SACVLC), pp. 29–34, 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/abstract/document/10347801

62. **Optimal User Slicing with Minimum Latency for Software Defined Networking**
A Viveros, P Adasme, E San Juan, I Soto, AD Firoozabadi
2023 South American Conference On Visible Light Communications (SACVLC), pp. 47–52 (1 citation), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347845

63. **RIS-Aided Federated Edge Learning Exploiting Statistical CSI**
H Li, R Wang, J Wu, W Zhang, I Soto
2023 IEEE/CIC International Conference on Communications in China (ICCC), pp. 1–6 (1 citation), 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10233543

64. **FPGAs-Based Edge Computing with Distributed Leader Election on Internet of Things**
D Vera, K Toledo, S Bolufé, C Fernández-Campusano
2023 South American Conference On Visible Light Communications (SACVLC), pp. 118–123, 2023.
https://ieeexplore-ieee-org.ezproxy.usach.cl/document/10347586

3.5 List of thesis developed in the project (mentioning if it is a PhD or a master thesis):

Título (Title)	**Estudiante (Student)**	**Periodo (Term)**	**Carrera (Program)**	**Jornada (Schedule)**	**Guía (Advisor)**
Enlace FSO de bajo costo para sistema de Comunicación Híbrido RF/FSO *Low-Cost FSO Link for RF/FSO Hybrid Communication Systems*	Sebastián Lara Salazar	1° 2023	Telecomm Engineering	Daytime	Ismael Soto / USACH
Desarrollo de un modelo híbrido para la estimación del rendimiento de baterías de litio de estado sólido *Development of a Hybrid Model for Performance Estimation of Solid-State Lithium Batteries*	Carlos Eduard Fernández Grandón	1° 2023	Master in science Electrical Engineering	Daytime	Ismael Soto / Wilson Alavia / USACH
Desarrollo de una ayuda electrónica al desplazamiento para personas con ceguera y discapacidad visual basado en inteligencia artificial *Development of an AI-Based Electronic Mobility Aid for Blind and Visually Impaired Individuals*	Nicolás Andrés Ibáñez Rojas	2° 2023	Telecomm Engineering	Daytime	Ismael Soto / USACH

Título (Title)	**Estudiante (Student)**	**Periodo (Term)**	**Carrera (Program)**	**Jornada (Schedule)**	**Guía (Advisor)**
Sistema de monitoreo en tiempo real de temperatura en alimentos proteicos de alta calidad para servicios de logística y distribución utilizando B5G, blockchain y encriptación cuántica *Real-Time Temperature Monitoring System for High-Quality Protein Foods in Logistics Using B5G, Blockchain and Quantum Encryption*	Eduardo Antonio Lira Tapia	2° 2023	Control Engineering	Daytime	Ismael Soto / USACH
Propuesta de topología de sensores con integración de tecnología 5G y microservicios para entorno minero *Sensor Topology Proposal Integrating 5G and Microservices for Mining Environments*	Jesús Ignacio Muñoz Sáez	1° 2024	Telecomm Engineering	Daytime	Ismael Soto / USACH
Implementación de sistema de comunicación por luz visible para el contexto de minería subterránea *Implementation of a Visible Light Communication System for Underground Mining Contexts*	Agustín Adolfo Mascaro Muñoz	2° 2024	Electronic Engineering	Daytime	David Zabala / UCM

Título (Title)	**Estudiante (Student)**	**Periodo (Term)**	**Carrera (Program)**	**Jornada (Schedule)**	**Guía (Advisor)**
Sistema de comunicación por luz visible basado en alineamiento entre el transmisor y el receptor para ambientes mineros subterráneos *Visible Light Communication System Based on Transmitter-Receiver Alignment for Underground Mining Environments*	Nicolás Endris Aravena Gómez	2° 2024	Electronic Engineering	Daytime	David Zabala / UCM
Desarrollo de una Red 5G-SA Open RAN Orientada a Redes Privadas *Development of a 5G-SA Open RAN Network for Private Deployments*	Gónzalo Alberto Maureria Jara	1° 2025	Master in science Electrical Engineering	Daytime	Cesar Azurdia / U. de Chile
Inteligencia Artificial para la Optimización de la Cobertura y Eficiencia Energética de Antenas Direccionales en Canales VLC Subterráneos *Artificial Intelligence for Optimizing Coverage and Energy Efficiency of Directional Antennas in Underground VLC Channels*	Ignacio Galeas	1° 2025 (defense scheduled for early April 2025)	Master in science Electrical Engineering	Daytime	Ismael Soto / USACH
From robustness to resilience: a framework for improving the availability of positioning services in indoor environments *Positioning Using VLC*	Cristobal Carreño	Defense scheduled for June 2025	PhD	Daytime	Nicolas Krommenacker / Patric Carpenter, University of Lorraine

3.6 List of Patents (in Study, Accepted. . .) Related to the Project

As part of the project's achievements, a patent application has been submitted to safeguard the technological innovations developed during its execution. In particular, patent application CL 202401953 was officially submitted, highlighting the project's significant contribution to advancing applied research and promoting innovation.

3.7 Cooperation Developed with the Private Sector During the Project

Throughout the development of the project, a strategic collaboration was established with the private sector, notably involving companies founded by alumni. Among them, *DIS SpA* played a key role in the formulation of new project proposals. Additionally, participation in the *Antofagasta Demo Day*—part of the *Innova+pymes* technology maturation program, held on Tuesday, December 12, 2023 at 10:00 a.m. in the Fundación Minera Escondida Auditorium, Antofagasta, Chile—supported the launch of a new *startup*, *TerraQuantum SpA*, founded by another alumnus. These partnerships fostered a dynamic exchange of ideas and enabled the implementation of cutting-edge solutions, significantly enhancing the project's success and impact.

3.8 Did the STIC-AmSud Program Help in Developing Other Relevant Initiatives?

(Research projects, European programs, bilateral programs, cooperation agreements, Cotutelles. . .):

Certainly, the support provided was instrumental to our success. We successfully concluded a FONDECYT project led by César Azurdia, and secured both a new FONDECYT grant and a project under the International Collaboration Promotion Program for Research Institutions, led by David Zabala. Additionally, Sandy Bolufé was awarded a FONDECYT Initiation Grant, and we also completed a FONDEF project under the direction of Ismael Soto.

Funding was obtained for two students, Raúl Zamorano and Francisco Rau, to pursue doctoral studies in Europe. Two additional ANID doctoral scholarships were awarded to Lídices Reyes and Carlos Fernández. Although we maintain active cotutelle agreements with institutions in France and the United Kingdom, we are currently considering prioritizing doctoral placements in the United States due to the ongoing conflict in Europe.

Collaboration across the three countries involved was highly productive. Despite limited funding availability in Ecuador, we maintained engagement with local institutions, successfully recruiting Kevin Valencia into the PhD program in Automation at USACH. We also submitted new project proposals in partnership with ESPE (Ecuador), and presented a proposal to an ANID Center Program to establish a transdisciplinary doctoral program in consortium with the University of Tarapacá and the Universidad Católica del Maule (UCM). In addition, academic Nicolas Krommenacker established new links with colleagues at Manchester Metropolitan University in the UK, and we submitted a proposal to a European research program.

Of the 109 research papers produced, not all explicitly acknowledge the STIC-AmSud program, although those that do are listed above. Nevertheless, the program played

a pivotal role in initiating key discussions, planning, and executing several significant initiatives.

3.9 Future Perspectives of Collaboration Between the Partners of the Project

Building upon the strong foundations established through the support of STIC-AmSud and the achievements to date, future collaboration among project partners holds great promise. The successful conclusion of research projects such as those led by César Azurdia, David Zabala, Sandy Bolufé, and Ismael Soto has fostered a dynamic research network that is poised for further growth.

In the near future, we plan to strengthen and expand doctoral mobility and research exchanges. With two students already funded for doctoral studies in Europe and two ANID scholarships awarded to Lídices Reyes and Carlos Fernández, we aim to enhance our cotutelle agreements and foster deeper engagement with institutions in the United States, considering the evolving geopolitical context in Europe.

We anticipate continued collaboration with Ecuadorian institutions, particularly ESPE, building on the recruitment of Kevin Valencia to the PhD program in Automation at USACH. Joint project proposals with Ecuador are expected to continue, with a focus on technological innovation and doctoral education.

A strategic priority will be the development of a transdisciplinary doctoral program, currently proposed to ANID, in partnership with the University of Tarapacá and Universidad Católica del Maule (UCM). This initiative will strengthen academic capacity across Latin America and enable collaborative doctoral training.

Further collaborations are also foreseen with European institutions. Notably, academic Nicolas Krommenacker will continue deepening ties with colleagues at Manchester Metropolitan University in the UK. Joint applications to European research programs will remain a central element of our internationalization strategy.

Although not all of the 109 research outputs to date explicitly reference the STIC-AmSud program, its role as a catalyst for scientific collaboration has been essential. Looking ahead, we envision STIC-AmSud as a key driver in the next phase of joint research, the inclusion of new partners, talent development, and institutional strengthening across participating countries.

During our visit to Quito, we spent the entire week participating in a conference organized by ESPE.

The future prospects for collaboration among new partners involved in the program's associated production reveal a dynamic and multifaceted research ecosystem, showcasing notable strengths across both foundational and applied research areas.

1. **Excellence in Visible Light Communication (VLC)**
   A substantial number of publications focus on VLC systems, addressing their performance in challenging environments such as underground mining, hospitals, underwater settings, and agriculture. This reflects the program's strong capabilities in designing innovative optical communication systems tailored to real-world constraints.

2. **Leadership in Machine Learning and Extreme Learning Machines (ELM)**
   The frequent application of ELM and deep learning across diverse tasks—ranging from biomedical signal processing and collision detection to energy efficiency and

predictive modeling—underscores the program's depth in data-driven technologies and intelligent systems.

3. **Pioneering Work in Intelligent Transportation and Safety Systems**
   The development of head-on collision warning systems, driver behavior monitoring, and cooperative vehicular communication reflects a proactive approach to smart mobility and public safety challenges.

4. **Strong Interdisciplinary Applications in Health and Environment**
   Contributions include the detection of cardiovascular and neurological diseases, digital health applications using IoT and VLC, and predictive models for environmental phenomena (e.g., river temperature and honey production). These works show the impact of the program on societal well-being and sustainability.

5. **Integration of Emerging Technologies in Edge Computing, IoT, and AI**
   Research on federated learning, edge computing architectures, and SDN-based privacy mechanisms demonstrate the program's orientation towards next-generation, decentralized systems with strong relevance for smart cities and autonomous vehicles.

6. **Commitment to Sustainability and Green Technologies**
   Multiple studies address energy efficiency, low-cost system design, and smart agriculture, reinforcing the program's alignment with sustainable development goals and responsible technological advancement.

7. **Robust International Collaboration**
   The diversity of co-authors and venues—including IEEE, Elsevier, and Springer—alongside citations and participation in international conferences, indicates strong global engagement and impact.

Evidence of the future prospects for collaboration among new partners involved in the program's associated production is reflected in the following list of publications:

1. **Statistical Modeling of Wall Roughness and Its Influence on NLOS VLC Channels in Underground Mining**
   S Cornejo, P Palacios Játiva, C Azurdia Meza, I Sánchez.
   Applied Sciences, 15(5):2364, 2025.

2. **Intelligent Reflective Surface-Assisted Visible Light Communication with Angle Diversity Receivers and RNN: Optimizing Non-Line-of-Sight Indoor Environments**
   M Román Cañizares, C Azurdia-Meza, P Palacios Játiva, et al.
   Applied Sciences, 15(3):1617, 2025.

3. **Evaluation of Pulse-Shaped Waveform Modulation for Event Camera-Based OCC Systems**
   JA Cubillo, V Guerra, C Azurdia-Meza, J Rabadan, R Perez-Jimenez.
   Electronics Letters, 61(1):e70216, 2025.

4. **Fingerprint Classification Based on Multilayer Extreme Learning Machines**

A Quinteros, D Zabala-Blanco.
Applied Sciences, 15(5):2793, 2025.

5. **Multi-Channel Speech Enhancement Using Labelled Random Finite Sets and a Neural Beamformer in Cocktail Party Scenario**
J Datta, A Dehghan Firoozabadi, D Zabala-Blanco, FR Castillo-Soria.
Applied Sciences, 15(6):2944, 2025.

6. **Development of Improved Deep Learning Models for Multi-Step Ahead Forecasting of Daily River Water Temperature**
M Gheisari, J Shafi, S Kosari, S Amanabadi, S Mehdizadeh, et al.
Engineering Applications of Computational Fluid Mechanics, 19(1):2450477, 2025.

7. **Road Crash Analysis and Countermeasures on Hilly Roads in a Developing Country Using iRAP**
A Kamalasekar, K Chandran, S Chowdry, JA Alzubi, R Murugesan, et al.
International Journal of Crashworthiness, 1–7, 2025.

8. **SOC-Based Simulation of 3D MIMO Mobile-to-Mobile Fading Channels: A Riemann Sum Approach**
CA Gutiérrez, RA Fabían-Rodríguez, FR Castillo-Soria, CA Azurdia-Meza, et al.
IEEE Open Journal of Vehicular Technology, 5:1–20 (4 citations), 2024.

9. **Design and Evaluation of a Visible Light Communication System under Varied Atmospheric Conditions for Smart and Sustainable Farming**
M Contreras-Pezoa, P Palacios-Játiva, C Azurdia-Meza, D Zabala-Blanco, M Ijaz, I Sánchez.
IEEE Access, 2024.

10. **On the Performance on 100 kbps Short-Range Wireless Optical Communication Using Visible Light**
D Zabala-Blanco, CA Azurdia-Meza, A Mascaró-Muñoz, N Aravena, I Soto, et al.
In *2024 IEEE Latin-American Conference on Communications (LATINCOM)*, pp. 1–6, 2024.

11. **Design and Implementation of a Low-Cost VLC Photovoltaic Panel-Based Receiver with Off-the-Shelf Components**
A González-Uriarte, C Azurdia, D Torreblanca, P Palacios-Játiva, et al.
In *2024 IEEE Latin-American Conference on Communications (LATINCOM)*, pp. 1–6, 2024.

12. **On the Performance of Image Transmission in an Indoor Visible Light Communication System**
G González, PP Játiva, CA Azurdia-Meza, D Zabala-Blanco, MG Gaitán, et al.
In *2024 IEEE Latin-American Conference on Communications (LATINCOM)*, pp. 1–6, 2024.

13. **Pulse Shaped SC-FDMA MIMO Systems with Reduced PAPR**
S Kamal, CA Azurdia-Meza, C Estevez.
In *2024 IEEE Latin-American Conference on Communications (LATINCOM)*, pp. 1–6 (1 citation), 2024.

14. **On the Performance of an Air-Water Visible Light Communication System**
    G Martínez, PP Játiva, MG Gaitán, CA Meza, N Boettcher, et al.
    In *International Conference on Advanced Research in Technologies, Information and Communication*, 2024.

15. **IoT Application Development: A Comprehensive Narrowband Connectivity Device Solution**
    M Moreno, A Núñez, J Sandoval, CA Azurdia-Meza, E Carrasco, et al.
    In *International Conference on Advanced Research in Technologies, Information and Communication*, 2024.

16. **LSTM-Based Head-on Collision Warning System with a Decentralized Radio Sensing Approach**
    JD Cárdenas, O Contreras-Ponce, CA Gutiérrez, R Aguilar-Ponce, et al.
    In *2024 IEEE 100th Vehicular Technology Conference (VTC2024-Fall)*, pp. 1–5, 2024.

17. **Detection and Classification of Cardiovascular Diseases Using Neural Networks**
    BE Zamorano, AD Firoozabadi, A Brutti, P Adasme, D Zabala-Blanco, et al.
    In *2024 Signal Processing: Algorithms, Architectures, Arrangements, and Applications (SPA)*, 2024.

18. **Road Incident Detection under Rate Adaptation-Based Congestion Control in Cooperative Vehicular Systems**
    S Bolufé, JF Silva, CA Azurdia-Meza, I Soto, S Céspedes.
    IEEE Access, 2024.

19. **NB-IoT Path Loss Experimental Measurements in Urban Outdoor Environments**
    M Moreno, D Oxman, J Sandoval, CA Azurdia-Meza, MG Gaitán, et al.
    In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (1 citation), 2024.

20. **Enhancing Green Underground VLC Channels with Polar Codes and Multiresolution Analysis**
    J Pereira, I Soto, P Adasme, G Gatica, P Palacios, C Azurdia, et al.
    In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)*, 2024.

21. **Analysis of a Visible Light Positioning Database in Extreme Learning Machines Applications**
    BL Soto, CA Azurdia-Meza, D Zabala-Blanco, I Soto, PP Játiva, et al.
    In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (1 citation), 2024.

22. **Performance Analysis of a VLC System Applied to a Hospital Environment for IoT-Based Smart Patient Monitoring**
    B Fernández, PP Játiva, CA Azurdia-Meza, N Boettcher, D Zabala-Blanco, et al.

In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (2 citations), 2024.

23. **Enhanced Epileptic Seizure Detection through Wavelet-Based Analysis of EEG Signal Processing**
S Urbina Fredes, A Dehghan Firoozabadi, P Adasme, D Zabala-Blanco, et al.
Applied Sciences, 14(13):5783 (7 citations), 2024.

24. **Experimental Evaluation of a Head-on Collision Warning System Fusing Machine Learning and Decentralized Radio Sensing**
JD Cárdenas, MAD Ibarra, O Contreras-Ponce, CA Gutiérrez, et al.
IEEE Sensors Journal (2 citations), 2024.

25. **Hybrid Digital Twin Model for Greenhouse and Underground Environments**
PP Játiva, I Soto, CA Azurdia-Meza, I Sánchez, R Wang, W Kern.
IEEE Access (5 citations), 2024.

26. **Performance Analysis of the Particle Swarm Optimization Algorithm in a VLC System for Localization in Hospital Environments**
DA Candia, PP Játiva, C Azurdia Meza, I Sánchez, M Ijaz.
Applied Sciences, 14(6):2514 (4 citations), 2024.

27. **A Hyper-Parameter Optimizer Algorithm Based on Conditional Opposition Local-Based Learning Forbidden Redundant Indexes Adaptive Artificial Bee Colony Applied to Regularized Extreme Learning Machine**
P Vasquez-Iglesias, AE Pizarro, D Zabala-Blanco, J Fuentes-Concha, et al.
Electronics, 13(23):4652 (1 citation), 2024.

28. **Aquila Optimizer for Hyperparameter Metaheuristic Optimization in ELM**
P Vasquez-Iglesias, D Zabala-Blanco, AE Pizarro, J Fuentes-Concha, et al.
In *Iberoamerican Congress on Pattern Recognition*, pp. 244–258, 2024.

29. **A Review on Predicting Bee Honey Production Using Machine Learning**
R Ahumada-García, IM Adasme, D Zabala-Blanco, XA López-Cortés, et al.
In *2024 43rd International Conference of the Chilean Computer Science Society (SCCC)*, 2024.

30. **Hyper-Parameter Optimization of Regularized-Extreme Learning Machine Using a Modified Opposition-Based Learning Artificial Bee Colony**
P Vasquez-Iglesias, AE Pizarro, D Zabala-Blanco, J Fuentes-Concha, et al.
In *2024 43rd International Conference of the Chilean Computer Science Society (SCCC)*, 2024.

31. **Diamond Prices Estimation with ELM-Based Regressors**
D Zabala-Blanco, J Ramírez, R Ahumada-García, M Flores-Calero, et al.
In *2024 43rd International Conference of the Chilean Computer Science Society (SCCC)*, 2024.

32. **Human Face Orientation Based on MobileNetV2 Architecture-Enhanced Convolutional Neural Network**
M Flores-Calero, N Betancourt, N Jacho-Guanoluisa, A Albuja, et al.
In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)*, 2024.

33. **Traffic Sign Detection and Recognition Using YOLO Object Detection Algorithm: A Systematic Review**
M Flores-Calero, CA Astudillo, D Guevara, J Maza, BS Lita, B Defaz, et al.
Mathematics, 12(2):297 (40 citations), 2024.

34. **Detection of Cardiovascular Diseases Using Predictive Models Based on Deep Learning Techniques: A Hybrid Neutrosophic AHP-TOPSIS Approach for Model Selection**
J Barzola-Monteses, R Caicedo-Quiroz, F Parrales-Bravo, et al.
Neutrosophic Sets and Systems, 74(1):18, 2024.

35. **Predicting Bacterial Antibiotic Resistance Using MALDI-TOF Mass Spectrometry Databases with ELM Applications**
V Macaya Mejias, D Zabala-Blanco, XA López-Cortés, F Tirado, et al.
Journal of Computer Science & Technology, 24 (3 citations), 2024.

36. **MRA-Based Digital Filter Using Daubechies 12 and Deep Learning for Exoplanet Light Curves**
E Toledo-Mercado, I Soto.
In *2024 43rd International Conference of the Chilean Computer Science Society (SCCC)*, 2024.

37. **Real-Time Anomaly Detection Algorithm for DoS Attacks in Communication Networks with IEDs Using IEC 61850**
T Castillo, I Soto, H Chávez.
In *International Conference on Advanced Research in Technologies, Information and Communication*, 2024.

38. **Frequency Event Identification by a LSTM Network Approach**
LG Pincheira, H Chavez, I Soto, J Quiroz.
In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)*, 2024.

39. **Optimizing Coverage and Energy in Underground Wireless Networks**
I Galeas-Cutiño, ME Zamora, I Soto.
In *International Conference on Advanced Research in Technologies, Information and Communication*, 2024.

40. **Adaptive MRA Digital Filter Using Wavelet, and NARX Neural Network for Ground-Based Transmission Spectroscopy**
E Toledo-Mercado, I Soto.
In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)* (1 citation), 2024.

41. **Automated Biological Analysis System: Integration of Chatbots and Edge Computing**
F Reveco-Toledo, I Soto, V García.
In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)*, 2024.

42. **Exploring Worst Arc Flow Minimization: A Comparative Study of a Provided Wireless Network and Its Derivation via Spanning Tree Topology**
P Adasme, A Viveros, I Soto, AD Firoozabadi, DZ Rodríguez.
In *International Conference on Mobile Web and Intelligent Information Systems (MobiWIS)*, 2024.

43. **Experimental Proof-of-Concept Design of Self-Power LiFi Communication System for IoT Applications**
F Vladuceanu, M Ijaz, S Ekpo, B Adebisi, I Soto, PP Játiva, S Ghafoor.
In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (1 citation), 2024.

44. **Impact of the CMOS Pixel Clock on Optical Camera Communication Using Rolling Shutter Mode**
R Zamorano-Illanes, Z Ghassemlooy, O Younus, X Li, S Zvánovec, I Soto, et al.
In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)*, 2024.

45. **Neural Network-Based Stress Detection in Crop Multispectral Imagery for Precision Agriculture**
L Reyes-Hung, I Soto, AK Majumdar.
In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (1 citation), 2024.

46. **Hybrid Model for Estimating State of Charge of Lithium-Ion Batteries**
C Fernandez-Grandon, W Alavia, I Soto.
In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)*, 2024.

47. **Optimal Design and Coverage for 5G Networks Operating in the mmWave Frequency Spectrum Using Mathematical Programming**
S Cordero, P Adasme, H Kaschel, I Soto.
In *2024 14th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)* (1 citation), 2024.

48. **Drone and Computer Vision-Based Detection of Aleurothrixus Floccosus in Citrus Crops**
B Vergara, K Toledo, C Fernández-Campusano, AR Santamaria.
In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)*, 2024.

49. **Boosting Federated Learning for Optimization LTE-RSRP Networks**
A Acuña-Avila, H Kaschel, ME Zamora, CG Fernandez, et al.

In *2024 IEEE International Conference on Automation/XXVI Congress of the Chilean Association of Automatic Control (ICA-ACCA)*, 2024.

50. **LMFLS: A New Fast Local Multi-Factor Node Scoring and Label Selection-Based Algorithm for Community Detection**
H Li, SS Nasab, H Roghani, P Roghani, M Gheisari, et al.
Chaos, Solitons & Fractals, 185:115126, 2024.

51. **Pursuing Optimization Using Multimodal Transportation System: A Strategic Approach to Minimizing Costs and CO2 Emissions**
I Derpich, C Duran, R Carrasco, F Moreno, C Fernandez-Campusano, et al.
Journal of Marine Science and Engineering, 12(6):976, 2024.

52. **A Novel Model for Efficient Cluster Head Selection in Mobile WSNs Using Residual Energy and Neural Networks**
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4 Program Observations

4.1 Point Out the Strong Points of the Program

The main strength lies in the opportunity to engage in dialogues with external colleagues, go beyond conventional frameworks, and collaborate in planning with independent individuals who are not immersed in the national context. This is particularly valuable, as basic research projects, by their very nature, tend to be closed and limited in scope.

Another outstanding aspect is its ability to provide continuous support, even in the absence of financial contributions from the counterpart, as demonstrated in the case of UTEG – School of Technologies, Guayaquil.

4.2 Point Out the Weaknesses of the Program

We did not find any weaknesses. Considering the amount of funding provided per country, the benefit it generates is invaluable. There are countries that do not fulfill their commitments, but that is not a problem of the STIC-AmSud program itself.