Damien Wohwe Sambo

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Damien Wohwe Sambo Damien Sambo (scholar)
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1. Current position (since March 2024)

Title of the position	Associate Professor
Research area	Internet of Things (IoT) and embedded systems
Institution	IMT (Institut Mines-Telecom) Nord Europe
Research Centre	Center for Education, Research and Innovation - Digital Systems (CERI-SN)
Research team	ARTS (Autonomous Resilient Systems)
Address	Rue Guglielmo Marconi, 59650 Villeneuve d'Ascq, France

2. Previous position (June 2022 - February 2024)

Title of the position	Post-doctoral fellow in Computer Science and Networks.
Research area	Internet of Things (IoT) and embedded systems
Institution	INRIA (French Institute for Research in Computer Science and Automation)
Research team	FUN (Self-organizing Future Ubiquitous Networks)
Address	40 Avenue Halley, 59650 Villeneuve d'Ascq, France

3. Education and university diplomas

2016 – 2021 **Ph.D. in Computer Engineering**, Co-direction *university of Ngaoundéré - university of Bremen*.
Title of the tesis: *Design of a wireless underground sensor network for precision agriculture*
Mention: Very Honourable (best distinction)
Thesis defended on 23 July 2021 with the following Jury

Joseph Yves Effa	Professor, university of Ngaoundéré	President
Georges Kouamou	Associate professor, university of Yaoundé I	Reporter
Jean Claude Kamgang	Professor, ENSAI Ngaoundéré	Reporter
Duplex Elvis Houpa D.	Associate professor, university of Ngaoundéré	Examiner
Anna Förster	Professor, university of Bremen	Supervisor
Blaise Omer Yenke	Associate professor, university of Ngaoundéré	Co-supervisor
Paul Dayang	Associate professor, university of Ngaoundéré	Co-supervisor

2012 – 2016 **Master of Science in Computer engineering**, university of Ngaoundéré.
field: Systems and Software in Distributed Environments.
Acquired skills: introduction to scientific research, parallel programming and distributed systems, algebraic cryptography (study of cryptosystems), software engineering, virtualisation and high-performance computing.
Thesis title: *An efficient approach to multithreading in wireless sensor networks (Une approche efficace de multithreading dans les réseaux de capteurs sans fils)*
Mention: Very good (best distinction)

3. Education and university diplomas (continued)

2009 – 2012 **Bachelor of Science in computer engineering**, university of Ngaoundéré.
field: Computer's network and Architecture.
Acquired skills: network addressing (IPv4 et IPv6), procedural programming (Pascal, C) and objects oriented (C++, Java), web programming (PHP, HTML, CSS, JavaScript), database, Linux Operating Systems.
Mention: Fairly good (Top of the class)

4. Research activities

Passionate about science and new technologies, my research focuses on the analysis and improvement of systems with limited resources, such as sensor nodes. More specifically, I'm interested in energy efficiency, improving the quality of service and reliability of Internet of Things applications.
In addition to my research work, I am also involved in other related activities, including organising scientific events such as workshops (of International Conference) and talks given at scientific conferences and events. My dynamism is also felt within the FUN research team to which I belong. I co-organise the bi-monthly seminars of the research team. I am also a member of several international and national conference program committees and a reviewer for well-known, peer-reviewed journals and conferences.

Post-doctoral fellow in Computer Science and Networks

2022 – today **INRIA Research Centre of the University of Lille, *FUN team***.
The current postdoc is part of the GoodFloow project funded by the Agence de la Transition Écologique. (ADEME[1]) aimed at switching from disposable cardboard industrial packaging to reusable packaging in order to eliminate packaging waste, reduce CO_2 emissions and improve the ergonomics of factory workstations using IoT devices. The problem tackled by this project lies in the transparent and precise assignment of a responsible party to each reusable packaging (from connected objects), which remains difficult to obtain to date.
Specifically, my work involves improving the environmental discovery phase of IoT devices attached to reusable packaging. As conventional localisation devices such as GPS have questionable accuracy, several wireless communication technologies embedded in the sensor are used. The use of these communication technologies and certain sensors makes it possible to understand the movements of the nodes and their environment by following the logic "Tell me what you see, I will tell you to whom you belong to". The sensor nodes used have a low energy footprint, enabling them to last longer than the life cycle of reusable packaging. ($\approx$ 7 years).

Application domains : *Industry 4.0* et *ecology*

Supervisor : Nathalie MITTON, *Director of Research*

[1] The French Agency for Ecological Transition

(continued)

Ph.D. student in Computer engineering

2016 – 2021 **University of Ngaoundéré - university of Bremen**, *UFD-MIAP*.

My thesis work focused on contributing to the design of a wireless underground sensor network for precision agriculture. First of all, I proposed a new path loss model for the underground environment, which was presented at the international conference IEEE LCN 2019 (see ref. [DAB2019] Section 4) and its extended version published in well-known IEEE Sensors Journal (IF 4.325) (see ref. [DAB2020]). Given the limited resources of IoT devices and the fact that the biggest peak in consumption occurs when a packet is sent, we then proposed a lightweight approach based on fuzzy logic that enables a sending node to predict whether or not a piece of data to be sent can be received by a remote node. This real-time prediction is based on the environment of the sending node and on certain other elements. This second major result was published in the journal Springer Wireless Networks (IF 2.701) (see ref. [DBA2022]) and presented early at the national conference LOREXP 2021 (see ref. [DB2021]). To make this approach more reliable, we assessed its energy consumption and integrated it into the MoleNet IoT system, which is dedicated to ecological monitoring and precision agriculture. In addition, I acquired expertise in the Machine Learning and Computational Intelligence techniques used by the new IoT clustering optimisation solutions. This study led to the publication of a review article in MDPI Sensors (IF 3.847).

During my thesis, I obtained 3 international mobility grants, two of them were awarded during my thesis (12 months in Senegal and 3 months in Germany) and the last (3 months in France) postponed because of the Covid19 pandemic was carried out after my Ph.D. defense.

Application domains : *Agriculture de précision* et *surveillance écologique*.

Supervisors : Prof.-Dr. Anna FÖRSTER, Pr. Blaise Omer YENKE et Pr. Paul DAYANG.

5. List of publications

Aiming for quality rather than quantity, I have published articles in journals with an impact factor and at national and international conferences. The articles I have published to date have more than **295 citations** (17/07/2024) with a **6 index factor** (ref. Google scholar).

Journaux

1. [DA2023] : ***Damien Wohwe Sambo*** and Anna Förster, "**Wireless Underground Sensor Networks: A Comprehensive Survey and Tutorial**"
   ACM Computing Surveys, vol. 56, no. 4, pp. 1-44
   DOI: 10.1145/3625388

2. [DJN2023] : ***Damien Wohwe Sambo***, Jens Dede, Nathalie Mitton and Anna Förster, "**FuzDeMa: A portable Fuzzy based Decision-Making tool for reliable communication in Wireless Underground Sensor Networks**"
   ITU Journal on Future and Evolving Technologies, vol. 4, no. 3, pp. 419-433
   DOI: 10.52953/IXIP2995

3. [DBA2022] : ***Damien Wohwe Sambo***, Blaise Omer Yenke, Anna Förster, Joseph Ndong, Paul Dayang, and Idrissa Sarr, "**A New Fuzzy Logic Approach for Reliable Communications in Wireless Underground Sensor Networks**", *Springer Nature - Wireless Networks*, vol. 28, no. 7, pp. 3275–3292, 2022, ISSN: 15728196.
   DOI: 10.1007/S11276-022-03008-7

4. [PCD2021] : Paul Dayang, Cyrille Sepele Petsou, and ***Damien Wohwe Sambo***, "**Combining Fuzzy Logic and k-Nearest Neighbor Algorithm for Recommendation Systems**", *International Journal of Information Technology and Computer Science*, vol. 13, no. 4, pp. 1–16, Aug. 2021, ISSN: 20749007.
   DOI: 10.5815/IJITCS.2021.04.01

5. [DAB2020] : ***Damien Wohwe Sambo***, Anna Förster, Blaise Omer Yenke, Idrissa Sarr, Bamba Gueye, and Paul

Dayang, "**Wireless underground sensor networks path loss model for precision agriculture (wusn-plm)**", *IEEE Sensors Journal*, vol. 20, no. 10, pp. 5298–5313, 2020.
DOI: 10.1109/JSEN.2020.2968351

6 [DBA2019] : ***Damien Wohwe Sambo***, Blaise Omer Yenke, Anna Förster, and Paul Dayang, "**Optimized Clustering Algorithms for Large Wireless Sensor Networks: A Review**", *Sensors (Switzerland)*, vol. 19, no. 2, pp. 1–27, 2019, ISSN: 1424-8220.
DOI: 10.3390/s19020322.

7 [BDA2016] : Blaise Omer Yenke, ***Damien Wohwe Sambo***, Abba Ari Adamo Ado, and Abdelhak Gueroui, "**MMEDD : Multithreading Model for an Efficient Data Delivery in wireless sensor networks**", *International Journal of Communication Networks and Information Security (IJCNIS)*, vol. 8, no. 3, pp. 179–186, 2016, ISSN: 2073-607X.
DOI: 10.17762/IJCNIS.V8I3.1787

Conférences Internationales

1 Nour El Hoda Djidi, ***Damien Wohwe Sambo***, Matthieu Gautier, Olivier Berder and Nathalie Mitton, "**WUBBLE: Energy Efficient BLE Neighborhood Discovery Leveraging Wake-up Radio**"
Algorithmics of Wireless Networks, 19th International Symposium on Algorithmics of Wireless Networks (ALGOWIN 2023), (Sept. 7–8, 2019), Amsterdam, Netherlands, 2023.

2 [DAB2019] : ***Damien Wohwe Sambo***, Anna Förster, Blaise Omer Yenke, and Idrissa Sarr, "**A New Approach for Path Loss Prediction in Wireless Underground Sensor Networks**", *in Proceedings - 2019 IEEE 44th Local Computer Networks (LCN Symposium 2019)*, (Oct. 14–17, 2019), Osnabrück, Germany, 2019, pp. 50–57.
DOI: 10.1109/LCNSymposium47956.2019.9000669

3 [DBI2019] : ***Damien Wohwe Sambo***, Blaise Omer Yenke and Idrissa Sarr, "**Precision agriculture of onions and garlics through a large wireless underground sensor network**", (*sans proceedings - 2019 9th ConfereNce sur la Recherche en Informatique et ses Applications (CNRIA 2019)*, (Apr. 24–28, 2019), Saint-Louis, Sénégal, 2019, pp. 1–4

Conférence Nationale

4 [DB2021] : ***Damien Wohwe Sambo*** and Blaise Omer Yenke, "**Using fuzzy logic for reliable communication in a wireless underground sensor network for precision agriculture**", *in Proceedings - 2021 1st International Conference Local Resource Exploitation (LOREXP 2021)*, (Apr. 20–23, 2021), Ngaoundéré, Cameroon, 2021, pp. 1–14.
URL: https://lorexp.org/using-fuzzy-logic-for-reliable-communication-in-a-wireless-underground-sensor-network-for-precision-agriculture/

6. Teaching activities

From 2018 to 2022, I worked as an external teacher for the Mathematics and Computer Science Department of the Faculty of Science at the University of Ngaoundéré. In addition, since October 2022, a few months after the start of my post-doctoral contract with the FUN team, I have also worked as a part-time lecturer and in charge of practical work (Travaux Pratiques or TP) for the University of Lille, the IMT Nord Europe and the Ecole Centrale de Lille. I have worked in several teaching units on networks and computer science in general, in two universities (in France and abroad) and with students at different levels of these universities (from L1 to M2) for more than **650 hours eq. TD**.
In addition to these teaching and TD/TP management experiences, I have also co-supervised a Master's student at the University of Ngaoundéré and a Master's 2 student (IoT) at the University of Lille.

Teaching and practical work

2023 – today

Ecole Centrale de Lille, France. Master in embedded systems
Role: Teaching (course + TP/TD)
Level: Master 2
Course title: Internet of Things (IoT)
Description: In this course, the notion and importance of the Internet of Things are recalled and the main wireless communication technologies used in the IoT are detailed. The course is designed to have a strong practical orientation to help students master the concepts presented.
Prerequisites: Python (micro-python), C, C++, creativity
Number of hours/year: 22h eq. TD

2022 – today

IMT Nord Europe, France. Master in Computer science
Role: Teaching (course + TP/TD)
Level and speciality: M2 ROC
Course title: Wireless Sensor Network (WSN)
Description: In this course, the notion of sensor network is detailed, then the main wireless communication technologies used in IoT are presented. The course is designed to have a strong practical focus to help students master the concepts presented.
Prerequisites: Python (micro-python), C, C++, creativity
Number of hours/year: 14h eq. TD

University of Lille, France. Master in Computer science
Role: Teaching (course + TP/TD)
Level and speciality: M2 Internet of Things (semester 1b)
Course title: Wireless networks for IoT (WSN)
Description: The aim of this course is to present in detail the main wireless communication technologies used in the IoT. The technologies are grouped into two categories: *short-range* and *long-range*; the choice of using one or the other will depend on the specifications of the final application. In addition, this course has a strong practical focus and students are expected to give practical and entertaining examples after the explanation of the working principle of a communication technology.
Prerequisites: Python (micro-python), C, C++, creativity
Number of hours/year: 27h eq. TD

Ecole Centrale de Lille, France. Master in Industry of the Future
Role: TP/TD
Level and speciality: M2 Industry 4.0
Course title: Industrial Internet of Things (IIoT)
Description: The aim of this TP is to introduce students to the programming of connected objects used in Industry 4.0. The emphasis is on the acquisition of data collected by sensors and their exchange using wireless technologies adapted to IIoT (Bluetooth Low Energy and LoRa). Students are given fun exercises to help them get to grips with connected objects.
materials: Programmable LoPy/FiPy boards (micro-python)
Number of hours/year: 16h eq. TD

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2020 – 2022 **University Institute of Technology of Ngaoundéré, Cameroon**. L1 & 2
Role: Teaching (course + TP/TD)
Level and speciality: First and Second years of software engineering
Course titles (2): Initiation to the software engineering (L1), object-oriented modelisation in UML (L2)
Descriptions: The initiation to the software engineering course given in the first year of the software engineering option is divided into two parts: introduction to information systems and introduction to software engineering. The aim of the course is to enable students to understand how an information system works and to use the methods: SADT, MERISE I & II for modelling an information system. The importance of software engineering is also discussed, as are its fundamental concepts and the drafting of specifications. The UML object-oriented modelling course for second-year students introduces the main UML languages (use case, class, activity, sequence, state) used in software engineering. For each of these courses, the practical and practical exercises provide a better grasp of the tools.
tools: SADT, MERISE, UML

2018 – 2022 **Faculty of Science of the University of Ngaoundéré, Cameroon**. Licence et Master in Computer science
Role: Teaching (course + TP/TD)
Levels: L1, L3 et M1
Course titles (4): Introduction to Computer Science (L1), web application engineering (L3), cloud computing (L3), entrepôts de données (M1)
Descriptions: The course Introduction to Computer Science (L1) introduces new students to the world of computing, and in particular to the manipulation of information by a computer. The main approaches to coding and representing information are presented in detail. Students on the Computer Science pathway have the opportunity to specialise in cloud computing (L3). To enable students to set up business intelligence databases, the Data Warehousing course is offered to first-year Masters students.
languages: C, HTML/CSS, PHP, JavaScript, Python

2017 – 2018 **Faculty of Science of the University of Ngaoundéré, Cameroon**. Degree in Mathematics and Computer Science
Roles: TP/TD
Levels: L1 et L2
Course titles (4): Computer architecture (L1 and L2)
Descriptions: During this year, I was recruited as a lecturer for the Mathematics and Computer Science Department of the Faculty of Science of the University of Ngaoundéré. For the TD part, I corrected the TD sheets with the students (L1 & L2) provided by the main teacher and the practical part was carried out through an introduction to the 8086 assembler.
languages: 8086 assembler

Supervision of students

2022 – today **University of Lille, France**. Master 2 in Computer Science.
Role: Supervision and monitoring
Speciality: Internet of Things (IoT)
Student: Alexandre JOUSSET
Thesis title : *Wireless system intercommunication in a high-risk system applied to the aeronautical field (Intercommunication de système sans fil dans un système haut risque appliqué au domaine de l'aéronautique)*
Description: The aim of this thesis is to analyse wireless intercommunications in a system that is exposed to major risks, such as aeronautics. The aim of this analysis is to improve the quality of service in these types of application.

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2020 – 2021 **The University of Ngaoundéré, Cameroon**. Master 2 of Science in Computer Science.
Role: Co-supervision
Speciality: Systems and Sofware in Distributed Environments (SLED)
Student: Cyrille SEPELE PETSOU
Thesis title : *Intelligent food recommendation system for people suffering from malaria or HIV/AIDS (Système intelligent de recommendation des mets pour des personnes atteintes de paludisme ou du VIH/SIDA)*
Description: this work proposes a new approach based on the combination of fuzzy logic and the *k-Nearest neighbor* (KNN). The proposed approach can be applied without any prior collection of user feedback and results in good recommendations. In addition, this solution uses fuzzy logic to infer values based on inputs and a set of rules. On the other hand, KNN uses the output values of the fuzzy system to perform certain search tasks based on existing distance measurements. This work culminated in the publication of the paper [PCD2021].

7. Services to the community

Organisation of scientific events

2024 **UN3E 2024**, Co organising chair.
1st International Workshop on Ubiquitous Networking for Extreme Environments and Emergency cases (UN3E 2024) co-located in The 15th International Conference on Ambient Systems, Networks and Technologies (ANT 2024), 23 - 25 April 2024 in Hasselt, Belgium.

LS-NOT 2024, Co organising chair.
2nd International Workshop on Long and Short Range Wireless Technologies Applied to IoT for Networks of Tomorrow (LS-NoT 2024) co-located in the 20th International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT 2024) from April 29th to May 1st, 2024 in Abu Dhabi, United Arab Emirates.

2023 **LS-NOT 2023**, Co organising chair.
1st International Workshop on Long and Short Range Wireless Technologies Applied to IoT for Networks of Tomorrow (LS-NoT 2023) co-located in the 19th International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT 2023), 19 - 21 June 2023 in Coral Bay, Pafos, Chypre.

Member of Technical Program Committee (TPC)

- **CIoT 2024**, 7th Conference on Cloud and Internet of Things.
  29 – 31 October 2024, Montreal, Canada.
- **WiMob 2024**, The 20th International Conference on Wireless and Mobile Computing, Networking and Communications.
  21 – 23 October 2024, Paris, France.
- **GoodIT 2024**, The 4th International Conference on Information Technology for Social Good.
  4 – 6 September 2024, Bremen, Germany.
- **DCOSS-IoT 2024**, The 20th Annual International Conference on Distributed Computing in Smart Systems and the Internet of Things.
  29 April – 1 May 2024, Abu Dhabi, United Arab Emirates.

7. Services to the community (continued)

- **ANT 2024**, The 15th International Conference on Ambient Systems, Networks and Technologies.
  23 - 25 April 2024, Hasselt, Belgium.
- **FCN 2024**, the International Conference on Future Communications and Networks.
  17 – 20 December 2023, Queenstown, New Zealand.
- **EUSPN-2023**, The 14th International Conference on Emerging Ubiquitous Systems and Pervasive Networks.
  7 - 9 November 2023, Almaty, Kazakhstan.
- **SAFER-TEA 2023**, EAI International Conference on Safe, Secure, Ethical, Responsible Technologies and Emerging Applications.
  25 - 27 October 2023, Yaoundé, Cameroon.
- **CNRIA' 2023**, 13th Conference on Research in Computer Science and its Applications.
  22 - 26 Mai 2023, Kanifing, Gambie.
- **AlgoTel et CoRes 2023**, 25ième édition AlgoTel et 8ième rencontre CoRes.
  25 - 27 May 2023, Cargèse, France.
- **ANT 2023**, The 14th International Conference on Ambient Systems, Networks and Technologies.
  15 - 17 Mars 2023, Leuven, Belgique.

Reviewer of scientific papers (web of science)

Journals
- *IEEE Internet of Things Journal*, *IEEE Sensors Journal*, *EURASIP* (Springer), *Computer Communications* (Elsevier), *Applied Soft Computing* (Elsevier), AEÜ (Elsevier), *Peerj Computer Science*, *Internal Journal of Parallel, Emergent and Distributed Systems*, etc.

Conferences
- *IEEE GLOBECOM 2022*, *MSN 2022*, *PerCom 2023*, *IEEE ICC 2023*, *ANT 2023*, *EUSPN 2023*, *WiMob 2024*, etc.

Other responsibilities

December 2022 – February 2024
- **Co-organiser of FUN team research seminars**.
  To encourage scientific research and the sharing of knowledge, bi-monthly seminars are organised within the FUN research team. My task is to co-organize this seminar by looking for people inside and outside the FUN team to give a scientific presentation lasting around 20 minutes.

8. Mobilities, vulgarisation and workshops

International mobilities

January - March 2022
- **AUF – Mathinbio Doctoral College**, Research grant within the FUN team, INRIA Research Centre of the University of Lille, France.

May - July 2021
- **ERASMUS +**, Research grant within ComNets research group, The university of Bremen, Germany.

December 2018 - December 2019
- **Intra ACP - ERMIT**, Doctoral research grant in the DataBase research team, Cheikh Anta Diop university of Dakar, Senegal.

8. Mobilities, vulgarisation and workshops (continued)

Scientific talks

Events

- **IHAD 2013**, 1 - 2 December 2022, The University of Luxembourg, Luxembourg.
  Title: *Design of a network of wireless sensors for precision agriculture in Africa.*

- **Journées LPWAN**, 7 - 8 July 2022, Toulouse, France.
  Title: *Contribution à la conception d'un réseau de capteurs sans fils enfouis sous la terre pour l'agriculture de précision.*

Invited talks

- **PASTA, INRIA**, 16th April 2024, Nancy, France.
  Title: *WUSN-PLM: Path Loss Model for Wireless Underground Sensor Networks*

- **ComNets, University of Bremen**, 17th January 2024, Bremen, Germany (Online).
  Title: *WUBBLE: Energy Efficient BLE Neighborhood Discovery Leveraging Wake-up Radio*

- **IIoT Department, Fortiss**, 1st August 2023, Münich, Germany.
  Title: *Connected Objects for a Green World ?*

- **COPAIN, INRAe**, 29th June 2023, Clermont-Ferrand, France.
  Title: *FuzDeMa : a portable fuzzy-based decision-making tool for reliable communication in WUSN* .

Workshop attended

- 12 - 14 January 2022 — **ACMAM - AIMS-Cameroon Mathematics and its Applications Meeting**. Limbé, Cameroon.
- 6 - 10 Décembre 2021 — **2nd Mathinbio doctoral college grouping (AUF)**, Yaoundé, Cameroon.
- 20 - 23 April 2021 — **LOREXP - International Conference Local Resource Exploiatation**, Ngaoundéré, Cameroon.
- 26 - 30 Octobre 2020 — **1st Mathinbio doctoral college grouping (AUF)**, Yaoundé, Cameroon.
- 25 - 28 April 2021 — **CNRIA - ConfereNce sur la Recherche en Informatique et ses Applications**, Saint-Louis, Senegal.

9. Other professional experience

2018 – 2022 — **Trainer on the analysis and the treatment of statistical data (Cameroon).** Association for the Promotion of Geomatics and Sustainable Development (AG2D).

- Getting started with IBM SPSS software ;
- Descriptive and inferential statistics (mono-variate and multi-variate).

2016 – 2022 — **Web developer full stack, (remotely).** Kountac inc.

• Frontend and backend development of the web application kountac.fr to promote African products using the symfony Framework;

- Maintenance and addition of new functions;
- Database management;

10. References

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