

CURRICULUM VITAE ABREVIADO (CVA) – Date: 13/12/2023

Part A. PERSONAL INFORMATION

First name	<i>Angel Maria</i>		
Family name	<i>Martin del Rey</i>		
Gender	<i>Male</i>	Birth date	<i>07/09/1972</i>
Social Security, Passport, ID number	<i>07953200F</i>		
e-mail	<i>delrey@usal.es</i>	<i>http://diarium.usal.es/delrey</i>	
Open Researcher and Contributor ID (ORCID)	<i>0000-0002-3600-0016</i>		

A.1. Current position

Position	<i>Full professor</i>		
Initial date	<i>17/10/2022</i>		
Institution	<i>Universidad de Salamanca</i>		
Department/Center	<i>Applied Mathematics</i>	<i>IUFFyM, Faculty of Science</i>	
Country	<i>Spain</i>	Teleph. number	<i>+34 669144059</i>
Key words	<i>Cybersecurity, Mathematical modeling, mathematical epidemiology, malware propagation, cellular automata, complex network analysis, cryptography.</i>		

A.2. Previous positions (research activity interruptions, indicate total months)

Period	Position/Institution/Country/Interruption cause
<i>2008-2022</i>	<i>Associate professor (T.U.)/Universidad de Salamanca/Spain</i>
<i>2005-2007</i>	<i>Research collaborator/Scientific Research Council (CSIC)/Spain</i>
<i>2003-2008</i>	<i>Associate professor (T.E.U.)/Universidad de Salamanca/Spain</i>
<i>1997-2003</i>	<i>Assistant professor/Universidad de Salamanca/Spain</i>

A.3. Education

PhD, Licensed, Graduate	University/Country	Year
<i>PhD in Mathematical Sciences</i>	<i>UNED-CSIC / Spain</i>	<i>2000</i>
<i>Lic. In Mathematical Sciences</i>	<i>Universidad de Salamanca / Spain</i>	<i>1996</i>

Part B. CV SUMMARY (max. 5000 characters, including spaces)

Angel Martin del Rey received the B.S. and M.S. degrees in Mathematical Sciences from Universidad de Salamanca (USAL) in 1996, and the Ph.D. degree in Mathematical Sciences from UNED/CSIC in 2000. Currently he is full professor of Applied Mathematics at Universidad de Salamanca (Spain) where, since 1997, he has held different positions. Also, he was external researcher associated to the Institute of Physical and Information Technologies, CSIC (Spain) during the period 2005-2007. Currently he is the chair of both the department of Applied Mathematics, and the MSC in Mathematical Modeling (USAL). During 2014-2018, he was the chair of the Institute of Fundamental Physics and Mathematics.

His research interests include mathematical epidemiology, mathematical models for cybersecurity, machine learning, cellular automata, and complex network analysis and applications. Currently he works on the design and analysis of mathematical models to simulate the propagation of different entities (biological agents, malware and fake news) using both classical techniques and novel methodologies. In fact, the great majority of the research projects he had participated are devoted to these topics. Specifically, he works on global and deterministic models (whose dynamics is governed by means of systems of ordinary differential equations), and on deterministic and stochastic individual-based models based on cellular automata or agents. In this sense he is interested in the use of emerging techniques such as advanced complex network analysis, machine learning and simplicial complex theory in the design of such models.



He is the author of 72 papers published in journals indexed in WoS/JCR, 47 conference proceedings indexed in WoS/CPCI-S, and 27 papers in other international journals.

He has participated in 28 research projects funded by European, national, regional and local agencies and entities, being the principal investigator in 14 of them. He is the coordinating researcher of the research group "Mathematical Modeling in Science and Technology (MOMACyT)", recognized as a Consolidated Research Unit (UIC 318) by Junta de Castilla y León (Spain). Moreover, he has supervised three PhD theses: J.D. Hernández who is assistant professor at Universidad de Extremadura and participates in this research proposal, S. Quintero who is assistant professor at Technological University of Panama, and F. Batista who works in a technology-based company. Currently he is supervising other 8 doctoral theses. He is member of the editorial board of the WoS/JCR indexed journals "Security and Communication Networks" (Wiley/Hindawi), "Mathematics" (MDPI) and "Open Physics" (De Gruyter). He is/has been editor of special issues appeared in "Mathematics", "Sensors", "Security and Communication Networks" and "Mathematical Biosciences and Engineering". He has also participated as a member of the scientific committee of national and international conferences (RECSI, CIBSI, CEDI, CISIS, DCAI, etc.) and also as chair of special sessions in some international conferences as the International Conference on Distributed Computing and Artificial Intelligence with the special session entitled "Theory and Applications of Mathematical Models in Computer Science and Artificial Intelligence".

He is evaluator of research proposals for national (ANEP, Spain) and international research agencies (FONDECYT, Chile), and reviewer of several journals indexed in WoS/JCR. He is scientific member of Spanish Royal Mathematical Society (RSME), Spanish Society of Applied Mathematics (SEMA), Spanish Artificial Intelligence Association (AEPIA), and European Mathematical Society (EMS).

Finally, he is member of the scientific dissemination committee of the Spanish Royal Mathematical Society and he regularly develops scientific dissemination activities including the organization of scientific exhibitions such as "Undergraph" at 2018 devoted to graph theory, publication of articles in general press, giving talks in high schools and participation as tutor in scientific training programs for young students.

Part C. RELEVANT MERITS (related to the subject matter of the research proposal)

C.1. Publications

- [1] E.E. Maurín Saldaña, **A. Martín del Rey**, A.B. Gil González (2023), An Approach to Simulate Malware Propagation in the Internet of Drones, *Lect. Notes. Netw. Syst.* 585: 197-203.
- [2] D. Hernández Serrano, **A. Martín del Rey** (2022) *Virtual cyclic cellular automata, finite group actions and recursive properties*, *Inform. Sci.* 608: 917-930.
- [3] L. Llamazares Elías, S. Llamazares Elías, **A. Martín del Rey** (2022) *An Analysis of Contact Tracing Protocol in an Over-Dispersed SEIQR Covid-Like Disease*, *Physica A* 590: 126754.
- [4] **A. Martín del Rey**, R. Casado Vara, S. Rodríguez González (2022) *A computational propagation model for malware based on the SIR classic model*. *Neurocomputing* 484: 161-171.
- [5] A. Tocino, **A. Martín del Rey** (2021) *Stochastic stability of SIRS models without Lyapunov functions*, *Commun. Nonlinear Sci. Numer. Simulat.* 103: 105956.
- [6] **A. Martín del Rey**, G. Hernández, A. Bustos Tabernero, A. Queiruga Dios (2021) *Advanced malware propagation on random complex networks*, *Neurocomputing* 423: 689-696.
- [7] J.D. Hernández Guillén, **A. Martín del Rey** (2020) *A mathematical model for malware spread on WSNs with population dynamics*, *Physica A* 545: Article ID 123609.
- [8] J.D. Hernández Guillén, **A. Martín del Rey**, R. Casado Vara (2019) *Security Countermeasures of a SCIRAS Model for Advanced Malware Propagation*, *IEEE Access* 7: 135472-135478.
- [9] **A. Martín del Rey**, L.-X. Yang, V.A. Karyotis (2019) *Mathematical Models for Malware Propagation*, *Secur. Comm. Netw.* 2019: Article ID 6046353.



- [10] J.D. Hernández Guillén, **A. Martín del Rey** (2018) *Modeling malware propagation using a carrier compartment*, *Commun. Nonlinear Sci. Numer. Simulat.* 56: 217-226.
- [11] **A. Martín del Rey**, J. Martín Vaquero, A. Hernández Encinas, A. Queiruga Dios, G. Rodríguez Sánchez (2016) *A method for malware propagation in industrial critical infrastructures*, *Integr. Comput.-Aided Eng.* 23: 255-268.

C.2. Congress

- [1] **Oral communication in DCAI'21**, Oct 6-Oct 8 2021, Salamanca (Spain): S. Llamazares Elías, A. Martín del Rey, *About the reversibility of elementary cellular automata with rule number 180*, *Lecture Notes in Network and Systems* 332 (2022) 131-140.
- [2] **Oral communication in CISIS'20**, Sep 16-Sep 18 2020, Burgos (Spain): J. D. Hernández Guillén, A. Martín del Rey, *Simulating malware propagation with different infection rates*, *Adv. Intell. Syst. Comput.* 1267 (2021) 253-262.
- [3] **Oral communication in DCAI'19**, Jun 26-Jun 28 2019 Ávila (Spain): A. Martín del Rey, A. Queiruga Dios, G. Hernández, A. Bustos Tabernero, *Modeling the spread of malware on complex networks*, *Adv. Intell. Syst. Comput.* 1004 (2020) 109-116.
- [4] **Oral communication in DCAI'19**, Jun 26-Jun 28 2019, Ávila (Spain): F. Batista Guerra, A. Martín del Rey, A. Queiruga Dios, *A review of SEIR-D agent based model*, *Adv. Intell. Syst. Comput.* 1004 (2020) 133-140.
- [5] **Oral communication in SOCO'17**, Sep 6-Sep 8, 2017, León (Spain): J.D. Hernández Guillén, A. Martín del Rey, L. Hernández Encinas, *New approaches of epidemics models to simulate malware propagation*, *Adv. Intell. Syst. Comput.* 649 (2018) 631-640.
- [6] **Oral communication in JNIC'16**, Jun 15-Jun 17 2016, Granada (Spain): J.D. Hernández Guillén, A. Martín del Rey, L. Hernández Encinas, *Propuesta de mejora de un modelo SEIRS para la simulación de la propagación de malware*, *Actas de las II Jornadas Nacionales de Investigación en Ciberseguridad*, P. García Teodoro, R. Rodríguez Gómez, J. López Muñoz (eds.), Universidad de Granada, pp. 136-143 (2016) ISBN nº 978-84-608-8070-7.
- [7] **Oral communication in JNIC 2015**, Sept 14-Sept 19, 2015, León (Spain), Ángel Martín del Rey, Ascensión Hernández Encinas, Jesús Martín Vaquero, Araceli Queiruga Dios, Gerardo Rodríguez Sánchez, *Propagación del malware: nuevos modelos para nuevos escenarios*, *Actas de las I Jornadas Nacionales de Investigación en Ciberseguridad*, Universidad de León, pp. 1-7 (2015) ISBN nº 978-84-9773-742-5.
- [8] **Oral communication in XIII RECSI**, Sept 3-Sept 5 2014, Alicante (Spain): Ángel Martín del Rey, Gerardo Rodríguez Sánchez, Amparo Fúster Sabater, *Simulación de la propagación de malware: modelos continuos vs. modelos discretos*, *Actas de la XIII RECSI*, Universidad de Alicante, pp. 139-144 (2014). ISBN nº 978-84-9717-323-0.
- [9] **Oral communication in CISIS'13**, Jul 11-Jul 17 2013, Ángel Martín del Rey, Gerardo Rodríguez Sánchez, *A CA model for mobile malware spreading based on bluetooth connections*, *Proceedings of the International Joint Conference SOCO'13-CISIS'13-ICEUTE'13* (E. Corchado et al. Eds.), *Adv. Intell. Soft Comput.* 239 (2014), 619-629. ISBN nº 978-3-319-01853-9.
- [10] **Oral communication in ECT 2010**, Sept 14-Sept 19 2010, M^a. José Fresnadillo Martínez, E. García Sánchez, J.E. García Sánchez, A. Martín del Rey, and G. Rodríguez Sánchez, *Epidemiological Modeling based on Dynamic Neighbourhoods*, *Proceedings of The Seventh International Conference on Engineering Computational Technology* (B.H.V. Topping, J.M. Adam, F.J. Pallarés, R. Bru and M.L. Romero, eds.), paper 98, ISBN nº 978-1-905088-40-9.

C.3. Research projects

- [1] Title: **Mathematical models in network security against emergent cyber-threats (TIN2017-84844-C2-2-R)**
P.I.: Ángel Martín del Rey
Funding entity: Ministerio de Economía y Competitividad, Spain (Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad, Convocatoria 2017).
Duration: 01/01/2018- 31/12/2020
Funding: 51.304 Euros
- [2] Title: **Mathematical models in Security, Defense and Cyber Defense: Design and Computational Implementation (SA054G18)**
P.I.: Ángel Martín del Rey



Funding entity: Consejería de Educación y Cultura, Junta de Castilla y León, Spain.

Duration: 01/01/2018- 31/12/2020

Funding: 12.000 Euros

[3] Title: **Mathematical models in cybersecurity: information protection against malware and other threats (TIN2014-55325-C2-2-R)**

P.I.: Ángel Martín del Rey

Funding entity: Ministerio de Economía y Competitividad (Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad, Convocatoria 2014, Modalidad 1: "Proyectos de I+D+I").

Duration: 01/01/2015- 31/12/2017

Funding: 43.560 Euros

[4] Title: **Efficient and secure technologies for wireless networks of Internet of Things with applications to transport and logistic (TIN2011-25452)**

P.I.: Pino Caballero Gil (Universidad de La Laguna).

Funding entity: Ministerio de Ciencia e Innovación.

Duration: 01/01/2012 – 31/12/2014

Funding entity: 65.100 Euros.

[5] Title: **Design of an epidemiological model based on cellular automata (FS22/2009)**

P.I.: Ángel María Martín del Rey

Funding entity: Fundación "Memoria D. Samuel Solórzano Barruso"

Duration: 01/01/2010-31/12/2010

Funding: 3.000 Euros

[6] Title: **Cellular automata: cryptographic applications (MTM2009-02773)**

P.I.: Ángel María Martín del Rey.

Funding entity: Ministerio de Ciencia e Innovación, Spain.

Duration: 01/01/2009 – 31/12/2011

Funding: 26.900 Euros.

[7] Title: **Desing of mathematical models for epidemic diseases (SAN673/SA23/08)**

P.I.: Ángel María Martín del Rey

Funding entity: Consejería de Sanidad, Junta de Castilla y León

Duration: 01/01/2008- 31/12/2008

Funding: 7.180 Euros

[8] Title: **Novel security protocols and cryptographic algorithms for protecting telematic services (TSI2007-62657)**

P.I.: Fausto Montoya Vitini (CSIC)

Funding entity: Ministerio de Educación y Ciencia

Duration: 2007-2008

Funding: 10.000 Euros

[9] Title: **Design of cryptographic protocols based on cellular automata (SA110A06)**

P.I.: Ángel María Martín del Rey

Funding entity: Consejería de Educación, Junta de Castilla y León

Duration: 2006-2008

Funding: 14.100 Euros

[10] Title: **Design of models based on cellular automata for studying, analysis and control of the epidemic diseases (SAN/1052/SA29/05)**

P.I.: Ángel María Martín del Rey

Funding entity: Consejería de Sanidad, Junta de Castilla y León

Duration: 2005

Funding: 5.989,78 Euros

C.4. Contracts, technological or transfer merits.

- Inventors: L. Hernández Encinas and A. Martín del Rey. Title: Method and apparatus for encrypting digital images. Number: 200201500. Priority country: Spain. Priority date: 28/6/2002. Entity: CSIC, Universidad de Salamanca.

- Inventors: L. Hernández Encinas, G. Álvarez Marañón and A. Martín del Rey. Title: Procedure and device for secretly dividing, sharing and recovering images. Number: 200302924. Priority country: Spain. Priority date: 10/12/2003. Number: 2 238 168. Date: 01/11/2006. Entity: CSIC, Universidad de Salamanca.