

Number of Collaborative activities for research, faculty exchange, student exchange per year (5)

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
1	Research	Dr. Y. H. Joo Professor Center for Wind Energy Systems Kunsan National University South Korea E-mail: yhjoo@kunsan.ac.kr	M. Syed Ali	DST-SERB	2017	Exchange of Ph.D. student	https://www.researchgate.net/profile/Young_Hoon_Joo
2	Research	Prof. Wong Jonathan W.C, Professor Hong Kong Baptist University, Hong Kong E-mail: jwcwong@hkbu.edu.hk	Dr. A. Rajasekar	Hong Kong Baptist University	2017	Exchange of Ph.D. student	https://researchportal.hkbu.edu.hk/portal/en/persons/pattanathu-rahman(55fa3ce1-7c8f-4334-b1e5-0862b075e280).html
3	Research	C. Subathra Devi, School of Biosciences and Technology, VIT University, Vellore, Tamil Nadu, India.	Dr. A. Panneerselvam	Thiruvalluvar University	2014	Joint Research Publication	http://rjptonline.org/AbstractView.aspx?PID=2014-7-5-16
4	Research	Jemimah Naine S, School of Biosciences and Technology, VIT University, Vellore, Tamil Nadu, India.	Dr. A. Panneerselvam	Thiruvalluvar University	2014	Joint Research Publication	http://rjptonline.org/AbstractView.aspx?PID=2014-7-5-16
5	Research	S.S. Khora, School of Biosciences and Technology, VIT University, Vellore, Tamil Nadu, India.	Dr. A. Panneerselvam	Thiruvalluvar University	2014	Joint Research Publication	http://rjptonline.org/AbstractView.aspx?PID=2014-7-5-16
6	Research	Shaik Jameel, School of Biosciences and Technology, VIT University, Vellore, Tamil Nadu, India.	Dr. A. Panneerselvam	Thiruvalluvar University	2014	Joint Research Publication	http://rjptonline.org/AbstractView.aspx?PID=2014-7-5-16
7	Research	Venkat Kumar, Mohanasrinivasan V School of Biosciences and Technology, VIT University, Vellore, Tamil Nadu, India.	Dr. A. Panneerselvam	Thiruvalluvar University	2014	Joint Research Publication	http://rjptonline.org/AbstractView.aspx?PID=2014-7-5-16
8	Research	Dr. Yeng Peng Ting, Associate Professor, Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore E-mail: chetyp@nus.edu.sg	Dr. A. Rajasekar	DBT, DST-SERB and National University of Singapore	2014	Joint Research Publication	https://www.eng.nus.edu.sg/chbe/staff/chetyp/
9	Research	Dr. I. V. Asharani, Dept. of Chemistry VIT	Dr. D. Thirumallai	VIT University	2014	Joint Research	https://scholar.google.com/citations?user=01wkjUkAAAAJ&hl=en

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10	Research	J.Hemapriya, Department of Microbiology, DKM College, Vellore, Tamilnadu, India	Dr. E.David	Thiruvalluvar University	2014	Joint Research Publication	http://www.ijcrar.com/vol-2-8/A.Shyamala,%20et%20al.pdf
11	Research	EK.Elumalai,Assistant Professor, Department of Applied Microbiology, Achariya Arts and Science College, Pudhucherry - 605 110. (India).	Dr. E.David	Thiruvalluvar University	2014	Joint Research Publication	https://pdfs.semanticscholar.org/5a42/71dd7a88d4dc50f4e885a58181f9ae884a59.pdf
12	Research	Narayanaswamy Tamilselvan,Post graduate and Research Department of Zoology, Physiology wing, Voorhees College, Vellore – 632001, Tamilnadu, India	Dr. E.David	Thiruvalluvar University	2014	Joint Research Publication	https://pdfs.semanticscholar.org/b527/991496872bec0e44ae62fc2f872c1a22510c.pdf
13	Research	T Thirumalai, P.G and Research Department of Zoology, Physiology Wing, Voorhees College, Vellore-632001, (T.N.), India	Dr. E.David	Thiruvalluvar University	2014	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S2221618914600081?via%3Dihub
14	Research	Govindaraju K, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India.	Dr. G. Singaravelu	Thiruvalluvar University	2014	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/25092583
15	Research	Kumar VG, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India.	Dr. G. Singaravelu	Thiruvalluvar University	2014	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/25092583
16	Research	Sadiq AM, Department of Biochemistry, Adhiparasakthi College of Arts and Science, Kalavai 632506, India.	Dr. G. Singaravelu	Thiruvalluvar University	2014	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/25092583

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17	Research	Dhas TS, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India.	Dr. G. Singaravelu	Thiruvalluvar University	2014	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/25092583
18	Research	Karthick V, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India.	Dr. G. Singaravelu	Thiruvalluvar University	2014	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/25092583
19	Research	K. Shameem Rani, Department of Zoology, M.S.S Wakf Board College, Madurai-625 020.	Dr. M. Chandran	Thiruvalluvar University	2014	Joint Research Publication	https://www.alliedacademics.org/articles/climate-changes-and-its-impact-on-fish-with-eference-to-antibiotic-resistant-enteric-bacteria-and-heavy-metal-https://www.alliedacademics.org/articles/climate-changes-and-its-impact-on-fish-with-eference-to-antibiotic-resistant-enteric-bacteria-and-heavy-metal-
20	Research	M. Mumtaz, Department of Zoology, M.S.S Wakf Board College, Madurai-625 020.	Dr. M. Chandran	Thiruvalluvar University	2014	Joint Research Publication	https://www.alliedacademics.org/articles/climate-changes-and-its-impact-on-fish-with-eference-to-antibiotic-resistant-enteric-bacteria-and-heavy-metal-https://www.alliedacademics.org/articles/climate-changes-and-its-impact-on-fish-with-eference-to-antibiotic-resistant-enteric-bacteria-and-heavy-metal-
21	Research	N.Komathi, Department of Chemistry, Muthurangam Govt. Arts College, Vellore-632 002, Tamil Nadu, India.	Dr. M.N. Arumugham	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://doi.org/10.1016/j.ica.2014.03.015
22	Research	A. Leelamani Department of Mathematics, Anna University Regional Centre, Coimbatore 641 047, India	Dr. R. Samidurai	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/10.1007/s00521-014-1545-9
23	Research	R. Raja, Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi 630 004, India	Dr. R. Samidurai	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/10.1007/s00521-014-1545-9
24	Research	U. K. Raja , Department of Mathematics, Anna University Regional Centre, Coimbatore 641 047, India	Dr. R. Samidurai	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/10.1007/s00521-014-1545-9

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25	Research	S. Senthilkumar, Department of Chemistry, Vignesh Polytechnic College, Tiruvannamalai, India.	Dr. S. Syed Shafi	Thiruvalluvar University	2014	Joint Research Publication	https://rasayanjournal.co.in/vol-7/issue_4/12_%20Vol.7_4_%20370-374,%202014,RJC-1179.pdf
26	Research	N. Padmanathan, Department of Physics, Anna University, Chennai – 600025, Tamilnadu, India	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://pubs.rsc.org/en/content/articlelanding/2014/ra/c4ra07705a#ldivAbstract
27	Research	Kamatchiammal Senthilkumar, National Environmental Engineering Research Institute, Chennai Zonal Laboratory, CSIR Complex, Chennai 600 113, India	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://doi.org/10.1016/j.msec.2014.09.028
28	Research	N. Selv, a Condensed Matter Laboratory, Department of Physics, Madras Institute of Technology, Anna University, Chennai 600044, Tamil Nadu, India	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://pubs.rsc.org/en/content/articlelanding/2014/ra/c4ra07705a#ldivAbstract
29	Research	S. Sankar, Tyndall National Institute, University College Cork, Lee Maltings, Dyke Parade, Cork, Ireland	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://pubs.rsc.org/en/content/articlelanding/2014/ra/c4ra07705a#ldivAbstract
30	Research	Saroja Veerappan, National Environmental Engineering Research Institute, Chennai Zonal Laboratory, CSIR Complex, Chennai 600 113, India	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://doi.org/10.1016/j.msec.2014.09.028
31	Research	Srinivasan Krishnan, a Department of Chemistry, MIT Campus, Anna University, Chennai 600 044, India	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://sci-hub.tw/https://doi.org/10.1016/j.msec.2014.09.028

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32	Research	Thiruppathiraja Chinnasamy, Division of Proteomics and Nanobiotechnology, Science for Life Laboratory, KTH-Royal Institute of Technology, Stockholm, Sweden	Dr.Dinakaran Kannaiyan	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/j.msec.2014.09.028
33	Research	Ayyasamy Kathiresan, School of Chemical Sciences, Bharathiar University, Coimbatore, India	Dr.Krishnan Srinivasan	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1080/00958972.2014.965697
34	Research	William T.A. Harrison, Department of Chemistry, University of Aberdeen, Aberdeen, Scotland	Dr.Krishnan Srinivasan	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1080/00958972.2014.965697
35	Research	Nirmala.P.Ratchagar, Department of Mathematics, Annamalai University, Annamalai Nagar, Chidambaram, Tamilnadu, India	Dr.M.chitra	Thiruvalluvar University	2014	Joint Research Publication	http://www.ijirset.com/upload/2014/august/22_Effects.pdf
36	Research	S. Parthasarathy, Annamalai University Associate Professor, Department of Statistics, Annamalai Nagar,Chidambaram,Tamilnadu ,India	Dr.M.chitra	Thiruvalluvar University	2014	Joint Research Publication	https://pdfs.semanticscholar.org/25b5/89062a5089d7a43bea702887b1b03fd1c94a.pdf
37	Research	P. Sekar, Annai Therasa Arts and Science College, Thirukazhukundram-603 106.	Dr.R. Babujanarthanam	Thiruvalluvar University	2014	Joint Research Publication	http://www.ijpsi.org/Papers/Vol3(12)/E0312017022.pdf
38	Research	P. Kavitha, PG and Research Department of Biochemistry, K. M. G. College of Arts and Science, Gudiyattam, Vellore, India	Dr.R. Babujanarthanam	Thiruvalluvar University	2014	Joint Research Publication	https://www.tandfonline.com/doi/abs/10.1080/15567036.2011.551920

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39	Research	Jothis Mathew, Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India	Dr.Subramanian Arivoli	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/S2222-1808(14)60729-5
40	Research	Palani Gunasekaran, King Institute of Preventive Medicine and Research, Chennai 600 032, Tamil Nadu, India	Dr.Subramanian Arivoli	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/S2222-1808(14)60729-5
41	Research	Arul Samraj, Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India	Dr.Subramanian Arivoli	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/S2222-1808(14)60729-5
42	Research	Murugesan Sakthivadivel, King Institute of Preventive Medicine and Research, Chennai 600 032, Tamil Nadu, India	Dr.Subramanian Arivoli	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/S2222-1808(14)60729-5
43	Research	Samuel Tennyson, Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India	Dr.Subramanian Arivoli	Thiruvalluvar University	2014	Joint Research Publication	http://scihub.tw/https://doi.org/10.1016/S2222-1808(14)60729-5
44	Research	Dr. Muthupandian Ashokkumar School of Chemistry, University of Melbourne, Parkville, Victoria, 3010, Australia	Dr. J. Madhavan	University of Melbourne	2015	Joint Research Publication	https://findanexpert.unimelb.edu.au/display/person1590
45	Research	Murthy.S.D.S, Department of Biochemistry, Sri Venkateswara University, Tirupati-517502, Andhra Pradesh, India.	Dr. . Babu Janarthanam	Thiruvalluvar University	2015	Joint Research Publication	https://pds.semanticscholar.org/7154/f82c46d3306e9e289319002e9fbccd7f72a8.pdf?_ga=2.81418263.1699173584.1564932274-1486486514.1543744019

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46	Research	Praveena.B, Department of Biochemistry, Sri Venkateswara University, Tirupati-517502, Andhra Pradesh, India.	Dr. . Babu Janarthanam	Thiruvalluvar University	2015	Joint Research Publication	https://pdfs.semanticscholar.org/7154/f82c46d3306e9e289319002e9fbccd7f72a8.pdf?_ga=2.81418263.1699173584.1564932274-1486486514.1543744019
47	Research	MANASA SATHEESH, Director, Genewin Biotech, Hosur, Krishnagiri, Tamil Nadu, India	Dr. A. PANNEERSELVA	Thiruvalluvar University	2015	Joint Research Publication	http://www.tjprc.org/publis hpapers/--1430999805-2.%20Zoology%20-%20IJZR%20-%20%20ESTIMATION%20OF%20ENZYMES%20ACTIVITIES%
48	Research	Devarajan Saravanan, Ratnam Institute of Pharmacy, Pidathapolur, Nellore, Andhra Pradesh, India	Dr. D. Thirumallai	Thiruvalluvar University	2015	Joint Research Publication	https://pdfs.semanticscholar.org/e693/a6c62d36fbae39db4823fc02e545a3b6376e.pdf
49	Research	Gopal Aravindan, Crystal growth and Crystallography Division, VIT University, Vellore 632 014, Tamil Nadu, India.	Dr. D. Thirumallai	Thiruvalluvar University	2015	Joint Research Publication	DOI:10.1039/C5RA11447K
50	Research	Viswambaran Asharani, Environmental and Analytical Chemistry Division, School of Advanced Sciences, VIT University, Vellore 632 014, Tamil Nadu, India.	Dr. D. Thirumallai	Thiruvalluvar University	2015	Joint Research Publication	DOI:10.1039/C5RA11447K
51	Research	Viswambaran Asharani, Environmental and Analytical Chemistry Division, School of Advanced Sciences, VIT University, Vellore 632 014, Tamil Nadu, India.	Dr. D. Thirumallai	Thiruvalluvar University	2015	Joint Research Publication	DOI:10.1039/C5RA11447K
52	Research	Viswambaran Asharani, Environmental and Analytical Chemistry Division, School of Advanced Sciences, VIT University, Vellore 632 014, Tamil Nadu, India.	Dr. D. Thirumallai	Thiruvalluvar University	2015	Joint Research Publication	https://pdfs.semanticscholar.org/e693/a6c62d36fbae39db4823fc02e545a3b6376e.pdf

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53	Research	Giridhara Krishna Thimmavajjula, Nanotechnology laboratory, Institute of Frontier Technology, Regional Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Tirupati – 517 502, A.P., India	Dr. E.David	Thiruvalluvar University	2015	Joint Research Publication	http://www.techno-press.org/fulltext/j_anr/anr3_2/anr0302004.pdf
54	Research	Naga Venkata Krishna Vara Prasad Tollamadugu, Nanotechnology laboratory, Institute of Frontier Technology, Regional Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Tirupati – 517 502, A.P., India	Dr. E.David	Thiruvalluvar University	2015	Joint Research Publication	http://www.techno-press.org/fulltext/j_anr/anr3_2/anr0302004.pdf
55	Research	Dr. John V Kennedy Principal Scientist, Team Leader Materials, national Isotope centre, Lower Hutt 5040, New Zealand.	Dr. Ernest David	Department of Biotechnology, Thiruvalluvar University.	2015	Joint Research Publication	https://www.macdiarmid.ac.nz/our-people/principal-investigators/show/dr-john-kennedy
56	Research	M. Elanchezhian, Department of Microbiology, Dr ALM Post Graduate Institute of Basic Medical Sciences, University of Madras, Chennai 600113, India.	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	DOI: 10.1016/j.msec.2014.11.043
57	Research	Dr. Pankaj Das, Department of Chemistry, Dibrugarh University, Dibrugarh, Assam, India. Email: pankajd29@yahoo.com	Dr. G. Singaravelu	DBT	2015	Joint Research Publication	https://www.dibru.ac.in/largefile/conference15/contact-us.html
58	Research	K. Govindaraju, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/26369012
59	Research	K.S. Uma Suganya, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	DOI: 10.1016/j.msec.2014.11.043

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60	Research	Sweta Sinha, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/26369012
61	Research	T. Stalin Dhas, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/26369012
62	Research	V. Ganesh Kumar, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/26369012
63	Research	V. Karthick, Nanoscience Division, Centre for Ocean Research, Sathyabama University, Chennai 600119, India	Dr. G. Singaravelu	Thiruvalluvar University	2015	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/26369012
64	Research	B. Neppolian, SRM Research Institute, SRM University, Kattankulathur, Chennai-603 203, India.	Dr. J. Madhavan	Thiruvalluvar University	2015	Joint Research Publication	http://scihub.tw/https://doi.org/10.4028/www.scientific.net/MSF.807.101
65	Research	Dr. M. A. Careem, Professor, University of malaya, Malasiya.	Dr. J. Madhavan	University of malaya	2015	Joint Research Publication	
66	Research	Dr. S. Sirish, Professor, NIT, Warangal.	Dr. J. Madhavan	NIT, Warangal.	2015	Joint Research Publication	
67	Research	Quanxin Zhu, School of Mathematical Sciences and Institute of Finance and Statistics, Nanjing Normal University, Nanjing 210023, China	Dr. M. Syed Ali	Thiruvalluvar University	2015	Joint Research Publication	DOI:10.1016/j.neucom.2015.04.023
68	Research	Hongwei Zhou, School of Information Engineering, Nanjing Xiaozhuang University, Nanjing 211171, Jiangsu, China.	Dr. R. Samidurai	Thiruvalluvar University	2015	Joint Research Publication	https://doi.org/10.1016/j.neucom.2015.10.103
69	Research	Hongwei Zhou, School of mathematics and information Technology Nanjing Xiaozhuang University, Nanjing, China., E-mail: davidzhou@njxzc.edu.cn.	Dr. R. Samidurai	DST-SERB	2015	Joint Research Publication	https://doi.org/10.1016/j.neucom.2015.10.103

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70	Research	Quanxin Zhu ,Department of Mathematics,University of Bielefeld, 33615 Bielefeld, Germany.,E-mail: zqx22@126.com	Dr. R. Samidurai	DST-SERB	2015	Joint Research Publication	https://doi.org/10.1016/j.jneucm.2015.10.103
71	Research	Quanxin Zhu, School of Mathematical Sciences and Institute of Finance and Statistics, Nanjing Normal University, Nanjing 210023, China	Dr. R. Samidurai	Thiruvalluvar University	2015	Joint Research Publication	https://doi.org/10.1016/j.iamc.2015.06.030
72	Research	R. Raja, Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi 630 004, India	Dr. R. Samidurai	Thiruvalluvar University	2015	Joint Research Publication	https://doi.org/10.1016/j.iamc.2015.06.030
73	Research	R. Raja, Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi 630 004, India	Dr. R. Samidurai	Thiruvalluvar University	2015	Joint Research Publication	https://doi.org/10.1016/j.jneucm.2015.10.103
74	Research	Parthasarathi Arunachalam Chettiar Kamatchi, Department of Zoology, Pachaiyappa's College for Men, Kanchipuram, Tamil Nadu 631501, India;	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	https://www.ingentaconnect.com/content/doi/23095288/2016/00000004/00000001/art00002
75	Research	Rajan Maheswaran, Department of Zoology, Pachaiyappa's College for Men, Kanchipuram, Tamil Nadu 631501, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	https://www.ingentaconnect.com/content/doi/23095288/2016/00000004/00000001/art00002
76	Research	Murugesan Sakthivadivel King Institute of Preventive Medicine and Research, Chennai-600 032, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://www.plantsjournal.com/vol3Issue4/Issue_july_2015/3-3-12.1.pdf
77	Research	Murugesan Sivakumar Department of Zoology, Madras Christian College, Chennai-600 059, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://www.plantsjournal.com/vol3Issue4/Issue_july_2015/3-3-12.1.pdf
78	Research	Palani Gunasekaran King Institute of Preventive Medicine and Research, Chennai-600 032, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://www.plantsjournal.com/vol3Issue4/Issue_july_2015/3-3-12.1.pdf

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79	Research	Rajasingh Raveen Department of Zoology, Madras Christian College, Chennai-600059, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://www.plantsjournal.com/vol3Issue4/Issue_july_2015/3-3-12.1.pdf
80	Research	Raveen R, Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://biopublisher.ca/index.php/imr/article/view/2049
81	Research	Samuel T, Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://biopublisher.ca/index.php/imr/article/view/2049
82	Research	Samuel Tennyson Department of Zoology, Madras Christian College, Chennai-600059, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2015	Joint Research Publication	http://www.plantsjournal.com/vol3Issue4/Issue_july_2015/3-3-12.1.pdf
83	Research	Dr. John V Kennedy Principal Scientist, Team Leader Materials, national Isotope centre, Lower Hutt 5040, New Zealand.	Dr. Syed Shafi	Department of Chemistry, Thiruvalluvar University.	2015	Joint Research Publication	https://www.gns.cri.nz/who/staff/3098.html
84	Research	A. N. Sabari Department of Microbiology and Molecular Genetics, University of the Punjab, Lahore 54590, Pakistan	Dr.A. Rajasekar	Thiruvalluvar University	2015	Joint Research Publication	http://sci-hub.tw/https://link.springer.com/article/10.1007/s13369-015-1590-4
85	Research	A. Rajasekar, Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore 117576, Singapore	Dr.A. Rajasekar	Thiruvalluvar University	2015	Joint Research Publication	http://sci-hub.tw/https://link.springer.com/article/10.1007/s13369-015-1590-4
86	Research	H. Z. Wadood, Department of Microbiology and Molecular Genetics, University of the Punjab, Lahore 54590, Pakistan	Dr.A. Rajasekar	Thiruvalluvar University	2015	Joint Research Publication	http://sci-hub.tw/https://link.springer.com/article/10.1007/s13369-015-1590-4

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87	Research	Y.-P. Ting Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore 117576, Singapore	Dr.A. Rajasekar	Thiruvalluvar University	2015	Joint Research Publication	http://scihub.tw/https://link.springer.com/article/10.1007/s13369-015-1590-4
88	Research	Dr. Quanxin Zhu, Professor, Department of Mathematics, Nanjing National University, China. E-mail: zqx22@126.com	Dr.M. Syed Ali	DBT, DST-SERB, UGC	2015	Joint Research Publication	
89	Research	Giovanni Benelli, Department of Agriculture, Food and Environment, University of Pisa, via del Borghetto 80, 56124 Pisa, Italy	Dr. A. Rajasekar	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s40735-016-0054-z
90	Research	Kadarkarai Murugan, Department of Zoology, Bharathiar University, Coimbatore 641 046, India	Dr. A. Rajasekar	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s40735-016-0054-z
91	Research	Marcello Nicoletti, Department of Environmental Biology, Sapienza University of Rome, Piazzale Aldo Moro 5, 00185 Rome, Italy	Dr. A. Rajasekar	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s40735-016-0054-z
92	Research	Indira Viswambaran Asharani Division of Environmental & Analytical Chemistry, VIT University vellore.	Dr. D. Thirumalai	Thiruvalluvar University	2016	Joint Research Publication	https://www.researchgate.net/publication/307565950_A_comprehensive_review_on_folklore_antidiabetic_plants
93	Research	Mandava Gowtham, Department of Computer Science and Engineering, Gayatri Vidya Parishad College of Engineering	Dr. D. Thirumalai	Thiruvalluvar University	2016	Joint Research Publication	https://www.researchgate.net/publication/307565950_A_comprehensive_review_on_folklore_antidiabetic_plants
94	Research	T. Giridhara Krishna, Nanotechnology Laboratory, Institute of Frontier Technology, Regional Agricultural Research Station, Acharya N G Ranga Agricultural University, Tirupati 517 502, AP, India	Dr. E. David	Thiruvalluvar University	2016	Joint Research Publication	DOI: 10.1007/s13204-015-0472-0

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95	Research	T. N. V. K. V. Prasad, Nanotechnology Laboratory, Institute of Frontier Technology, Regional Agricultural Research Station, Acharya N G Ranga Agricultural University, Tirupati 517 502, AP, India	Dr. E. David	Thiruvalluvar University	2016	Joint Research Publication	DOI: 10.1007/s13204-015-0472-0
96	Research	Singaravelu Ajithkumar, Madha Dental College and Hospital, Chennai 600 069, India	Dr. G. Singaravelu	Thiruvalluvar University	2016	Joint Research Publication	researchgate.net/publication/309080128_Aegiceras_corniculatum-Mediated_Green_Synthesis_of_Silver_Nanoparticles_Bio-physical_Characterization_and_Cytotoxicity_on_Vero_Cells
97	Research	Karthikeyan Sivashanmugam, School of Bioscience and Technology, VIT University, Vellore 632 014, India	Dr. G. Singaravelu	Thiruvalluvar University	2016	Joint Research Publication	researchgate.net/publication/309080128_Aegiceras_corniculatum-Mediated_Green_Synthesis_of_Silver_Nanoparticles_Bio-physical_Characterization_and_Cytotoxicity_on_Vero_Cells
98	Research	Marcello Nicoletti, Department of Environmental Biology, Sapienza University of Rome, Piazzale Aldo Moro 5, 00185 Rome, Italy	Dr. G. Singaravelu	Thiruvalluvar University	2016	Joint Research Publication	researchgate.net/publication/309080128_Aegiceras_corniculatum-Mediated_Green_Synthesis_of_Silver_Nanoparticles_Bio-physical_Characterization_and_Cytotoxicity_on_Vero_Cells
99	Research	Giovanni Benelli, Department of Agriculture, Food and Environment, University of Pisa, via del Borghetto 80, 56124 Pisa, Italy	Dr. G. Singaravelu	Thiruvalluvar University	2016	Joint Research Publication	researchgate.net/publication/309080128_Aegiceras_corniculatum-Mediated_Green_Synthesis_of_Silver_Nanoparticles_Bio-physical_Characterization_and_Cytotoxicity_on_Vero_Cells

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100	Research	Dr. sakthivel, ARCI, Hyderabad.	Dr. J. Madhavan	ARCI, Hyderabad.	2016	Joint Research Publication	
101	Research	Acharya N G Ranga Agricultural University Hyderabad, India Join institution	Dr. M. Babujanathanam	Thiruvalluvar University	2016	Joint Research Publication	https://www.researchgate.net/publication/309598327_Synthesis_characterization_and_dose_dependent_antimicrobial_and_anti-cancerous_activity_of_phyco-genic_silver_nanoparticles_against_human_hepatic_carcinoma_HepG2_cell_line
102	Research	Rakesh Kumar, Department of Chemistry, DAV University, Jalandhar-144012 (Punjab) India.	Dr. M.N. Arumugham	Thiruvalluvar University	2016	Joint Research Publication	DOI: doi: 10.1016/j.molliq.2016.06.055
103	Research	P. Kavitha, Department of Zoology, Voorhees College, Vellore-1, India.	Dr. R. Babujanathanam	Thiruvalluvar University	2016	Joint Research Publication	https://www.ijcmas.com/vol-2-8/Devipriya%20Anbumani,%20et%20al.pdf
104	Research	Ahmed Alsaedi, Nonlinear Analysis and Applied Mathematics (NAAM) Research Group, Department of Mathematics, Faculty of Science, King Abdulaziz University, Jeddah 21589, Saudi Arabia	Dr. R. Samidurai	Thiruvalluvar University	2016	Joint Research Publication	DOI: 10.1007/s11571-016-9396-y
105	Research	Jinde Cao, Department of Mathematics, and Research Center for Complex Systems and Network Sciences, Southeast University, Nanjing 210 096, China	Dr. R. Samidurai	Thiruvalluvar University	2016	Joint Research Publication	DOI: 10.1007/s11571-016-9396-y
106	Research	Quanxin Zhu School of Mathematical Sciences and Institute of Finance and Statistics, Nanjing Normal University, Nanjing 210023, Jiangsu, China	Dr. R. Samidurai	Thiruvalluvar University	2016	Joint Research Publication	sciencedirect.com/science/article/pii/S0925231215015313?via%3Dihub#!

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
107	Research	R. Raja Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi - 630 004, India	Dr. R. Samidurai	Thiruvalluvar University	2016	Joint Research Publication	sciencedirect.com/science/article/pii/S0925231215015313?via%3Dihub#!
108	Research	Zhangsong Yao School of Mathematics and Information Technology, Nanjing Xiaozhuang University, Nanjing 211171, Jiangsu, China	Dr. R. Samidurai	Thiruvalluvar University	2016	Joint Research Publication	sciencedirect.com/science/article/pii/S0925231215015313?via%3Dihub#!
109	Research	Manickam Jayakumar Department of Zoology, University of Madras, Chennai 600 025, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2016	Joint Research Publication	https://pdfs.semanticscholar.org/cbb5/005d18bee266ee31b418dd65a30d0f63dc94.pdf?_ga=2.186216489.1699173584.1564932274-1486486514.1543744019
110	Research	Marimuthu Govindarajan Unit of Vector Control, Phytochemistry and Nanotechnology, Department of Zoology, Annamalai University, Annamalainagar 608 002, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2016	Joint Research Publication	https://pdfs.semanticscholar.org/cbb5/005d18bee266ee31b418dd65a30d0f63dc94.pdf?_ga=2.186216489.1699173584.1564932274-1486486514.1543744019
111	Research	Rajasingh Raveen Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2016	Joint Research Publication	https://pdfs.semanticscholar.org/cbb5/005d18bee266ee31b418dd65a30d0f63dc94.pdf?_ga=2.186216489.1699173584.1564932274-1486486514.1543744019
112	Research	Samuel Tennyson Department of Zoology, Madras Christian College, Chennai 600 059, Tamil Nadu, India.	Dr. S. Arivoli	Thiruvalluvar University	2016	Joint Research Publication	https://pdfs.semanticscholar.org/cbb5/005d18bee266ee31b418dd65a30d0f63dc94.pdf?_ga=2.186216489.1699173584.1564932274-1486486514.1543744019
113	Research	M. Akkulu Naidu, Department of Biotechnology, Mandsaur Institute of Pharmacy, Mandsaur, Madhya Pradesh, India,	Dr.E. David	Thiruvalluvar University	2016	Joint Research Publication	https://www.greenpharmacy.info/index.php/ijgp/article/view/647/530

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114	Research	Thirunavukkarasu Thirumalai1, Department of Zoology, Muthurangam Government Arts College, Otteri, Vellore, Tamil Nadu, India,	Dr.E. David	Thiruvalluvar University	2016	Joint Research Publication	https://www.greenpharmacy.info/index.php/iigp/article/view/647/529
115	Research	A.K. Arof Centre for Ionics University Malaya, Department of Physics, University of Malaya, Kuala Lumpur 50603, Malaysia	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S002459616302808?via%3Dihub#!
116	Research	B. Neppolian SRM Research Institute, SRM University, Kattankulathur 603203, Tamil Nadu, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0927024816300472?via%3Dihub#!
117	Research	D. Praveen Kumar Nano Catalysis and Solar Fuels Research Laboratory, Department of Materials Science and Nanotechnology, Yogi Vemana University, Vemanapuram, Kadapa 516003, Andhra Pradesh, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0927024816300472?via%3Dihub#!
118	Research	G. Muralidharan, Department of Physics Gandhigram Rural Institute-Deemed University Dindigul India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s10854-016-5214-x
119	Research	K. Amarsingh Bhabu, Department of Physics Manonmaniam Sundaranar University Tirunelveli India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s10854-016-5214-x
120	Research	K.Murugan, Department of Zoology, Bharathiar University, Coimbatore 641046, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S002459616302808?via%3Dihub#!
121	Research	Kanagaraj Amarsingh Bhabu, Department of Physics and Department of Renewable Energy Science, Manonmaniam Sundaranar University, Tirunelveli 627 012, Tamilnadu, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://pubs.acs.org/doi/pdf/10.1021/acs.jpcc.6b05873

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122	Research	M. Karthik CIC Energigune, Energy Cooperative Research Centre, Parque Tecnológico, C/Albert Einstein, 48, 01510 Miñano, Álava, Spain	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0927024816300472?via%3Dihub#!
123	Research	M. Raghavender Department of Physics, Yogi Vemana University, Kadapa 516003, Andhra Pradesh, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0022459616300986?via%3Dihub#!
124	Research	M.V. Shankar Nano Catalysis and Solar Fuels Research Laboratory, Department of Materials Science and Nanotechnology, Yogi Vemana University, Vemanapuram, Kadapa 516003, Andhra Pradesh, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0927024816300472?via%3Dihub#!
125	Research	N. Lakshmana Reddy Nano Catalysis and Solar Fuels Research Laboratory, Department of Materials Science and Nanotechnology, Yogi Vemana University, Vemanapuram, Kadapa 516003, Andhra Pradesh, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0927024816300472?via%3Dihub#!
126	Research	PrabhakarnArunachalam, Electrochemistry Research Group, Chemistry Department, College of Science, King Saud University, Riyadh 11451, Saudi Arabia	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0022459616302808?via%3Dihub#!
127	Research	T. Balu, Department of Physics Aditanar College of Arts and Science TiruchendurIndia.	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s10854-016-5214-x
128	Research	T. R. Rajasekaran, Department of Renewable Energy Science Manonmaniam Sundaranar University TirunelveliIndia	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://link.springer.com/article/10.1007/s10854-016-5214-x
129	Research	Thangaraj Balu, Department of Physics, Aditanar College of Arts and Science, Tiruchendur 628 216, Tamilnadu, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://pubs.acs.org/doi/pdf/10.1021/acs.jpcc.6b05873

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130	Research	Thanjavur Renganathan Rajasekaran, Department of Physics and Department of Renewable Energy Science, Manonmaniam Sundaranar University, Tirunelveli 627 012, Tamilnadu, India	Dr.J. Madhavan	Thiruvalluvar University	2016	Joint Research Publication	https://pubs.acs.org/doi/pdf/10.1021/acs.jpcc.6b05873
131	Research	Dr. Jinde Cao Distinguished Professor, Distinguished Professor, IEEE Fellow Head, Department of Mathematics, Director, Research Center for Complex Systems and Network Sciences, Southeast University, Nanjing - 210 096, China. E-Mail: jdcao@seu.edu.cn	Dr.R.Samidurai	DST	2016	Joint Research Publication	DOI: 10.1007/s11571-016-9396-y
132	Research	K. Subramanian, Department of Chemistry, Anna University, Guindy, Chennai- 600 025, India	K. Dinakaran	Thiruvalluvar University	2016	Joint Research Publication	DOI:10.1039/C6AN00879H
133	Research	K. Srinivasan, Department of Chemistry, Anna University, Guindy, Chennai- 600 025, India	K. Dinakaran	Thiruvalluvar University	2016	Joint Research Publication	DOI:10.1039/C6AN00879H
134	Research	K.Murugan, Department of Zoology, Bharathiar University, Coimbatore 641046, India	K. Dinakaran	Thiruvalluvar University	2016	Joint Research Publication	DOI:10.1039/C6AN00879H
135	Research	Dr. Fathella A Rehan Professor UAE University, UAE. E-mail: frihan@uaeu.ac.ae	M. Syed Ali	DST-SERB, UGC	2016	Joint Research Publication	https://cos.uaeu.ac.ae/en/departments/physics/profile.shtml?email=fhamed
136	Research	Dr. Griengrai Ratchagit, Associate Professor Maejo University Thailand Email: ratchagit@gmail.com	M. Syed Ali	DST, CSIR	2016	Joint Research Publication	https://scholar.google.com/citations?user=OkSODE4AAA&hl=en

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
137	Research	Dr. Jinde Cao, Distinguished Professor, Department of Mathematics, Southeast University China E-mail: jdcaoseu@gmail.com	M. Syed Ali	DST-SERB, CSIR and NBHM	2016	Joint Research Publication	https://www.researchgate.net/institution/Maejo_University
138	Research	Dr. Sabri Arik Professor, Istanbul University, Turkey E-mail: ariks@istanbul.edu.tr	M. Syed Ali	DBT, DST-SERB, UGC	2016	Joint Research Publication	
139	Research	T.N. Baskaran, Biotechnology division, Bharat Biotech international Pvt. Limited., Hyderabad, India	Dr. A. Rajasekar	Thiruvalluvar University	2016	Joint Research Publication	https://www.ijcmas.com/vol-2-8/Devipriya%20Anbumani,%20et%20al.pdf
140	Research	Abdullah A. Alarfaj Department of Botany and Microbiology, College of Science, King Saud University, Riyadh 11451, Saudi Arabia	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
141	Research	Akon Higuchi Department of Chemical and Materials Engineering, National Central University, Taoyuan, 32001 Taiwan Department of Botany and Microbiology, College of Science, King Saud University, Riyadh 11451, Saudi Arabia	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
142	Research	Al Thabiani Aziz Faculty of Science, Department of Biology, University of Tabuk, 71491, Saudi Arabia	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
143	Research	Amuthvalli Pandiyan Department of Zoology, Bharathiar University, Coimbatore 641 046, India	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
144	Research	Angelo Canale Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!

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145	Research	Baskaralingam Vaseeharan Biomaterials and Biotechnology in Animal Health Lab, Department of Animal Health and Management, Alagappa University, Karaikudi 630004, Tamil Nadu, India	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
146	Research	Chellasamy Panneerselvam Faculty of Science, Department of Biology, University of Tabuk, 71491, Saudi Arabia	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
147	Research	Devakumar Dinesh Department of Zoology, Bharathiar University, Coimbatore 641 046, India	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
148	Research	Dr. Akon Higuchi Professor Department of Chemical and Materials Engineering, National Central University, Taiwan (R.O.C.)E-mail: higuchi@ncu.edu.tw	Dr. A. Rajasekar	DBT, DST-SERB,	2017	Joint Research Publication	http://140.115.55.13/english.php?apps=faculty&action=more&id=22
149	Research	Dr. Giovanni Benelli Research Professor Department of Agriculture, Food and Environment, University of Pisa, Italy Email:benelli.giovanni@gmail.com	Dr. A. Rajasekar	DBT, DST-SERB,	2017	Joint Research Publication	https://peerj.com/GBenelli/
150	Research	Dr. Govarathanan Muthusamy Department of Applied Sciences, College of Environmental Technology, Muroran Institute of Technology, Muroran Institute of Technology, Japan E-mail: gova.muthu@gmail.com	Dr. A. Rajasekar	Muroran Institute of Technology, Japan	2017	Joint Research Publication	https://www.muroran-it.ac.jp/en/
151	Research	Dr. Laura L. Machuca, Curtin Corrosion Engineering Industry Centre, School of Chemical and Petroleum Engineering, curtin University,E-mail: l.machuca2@curtin.edu.au	Dr. A. Rajasekar	DBT, DST-SERB, UGC	2017	Joint Research Publication	https://research.curtin.edu.au/supervisor/dr-laura-machuca-suarez/

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
152	Research	Dr. Manivannan Sethurajan Universite Paris-Est, Laboratoire Geomateriaux et Environnement (LGE), Marne-la-Vallee, France E-mail: biotekmani@gmail.com	Dr. A. Rajasekar	DBT, DST-SERB,	2017	Joint Research Publication	https://www.un-ihc.org/user?destination=node/585698
153	Research	Dr. Obulisamy Parthiba Karthikeyan Research Assistant Professor Hong Kong Baptist University Hong Kong E-mail:opkens@gmail.com	Dr. A. Rajasekar	DBT, DST-SERB, UGC	2017	Joint Research Publication	https://www.researchgate.net/institution/Hong_Kong_Baptist_University
154	Research	Dr. Pattanathu Rahman Course Leader – Food Sci & Biotech.Teesside University, United Kingdom EEmail:p.rahman@tees.ac.uk	Dr. A. Rajasekar	DBT, DST-SERB, UGC	2017	Joint Research Publication	
155	Research	Giovanni Benelli Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
156	Research	Jiang-Shiou Hwang Institute of Marine Biology, National Taiwan Ocean University, Keelung 20224, Taiwan	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
157	Research	Kadarkarai Murugan Department of Zoology, Bharathiar University, Coimbatore 641 046, India	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
158	Research	Kandasamy Kalimuthu Institute of Marine Biology, National Taiwan Ocean University, Keelung 20224, Taiwan	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
159	Research	Suresh Kumar Department of Medical Microbiology and Parasitology, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
160	Research	Vasu Sujitha Department of Zoology, Bharathiar University, Coimbatore 641 046, India	Dr. A. Rajasekar	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0166445X17301170#!
161	Research	Dr. M. Raghavendhar Rao, Yogi Vemana University Kadppah	Dr. J. Madhavan	Yogi Vemana University Kadppah	2017	Joint Research Publication	
162	Research	Akon Higuchi, Department of Chemical and Materials Engineering, National Central University, No. 300, Jhongli, Taoyuan 32001, Taiwan	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0105-0
163	Research	Anitha Jaganathan, Division of Entomology, Department of Zoology, School of Life Sciences, Bharathiar University, Coimbatore, Tamilnadu 641046, India	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0105-0
164	Research	Giovanni Benell, The BioRobotics Institute, Scuola Superiore Sant'Anna, Viale Rinaldo Piaggio 34, 56025 Pontedera, Pisa, Italy	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0105-0
165	Research	Pandian Amuthavall, Division of Entomology, Department of Zoology, School of Life Sciences, Bharathiar University, Coimbatore, Tamilnadu 641046, India	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0105-0
166	Research	Pattanathu K. S. M. Rahman, Technology Future Institute, Teesside University, School of Science and Engineering, Middlesbrough, Tees Valley TS13BA, UK	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0105-0
167	Research	V. Devi Rajeswari Department of Biomedical Sciences, School of Biosciences and Technology, VIT University, Vellore 632014, Tamil Nadu, India	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5655386/pdf/main.pdf

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
168	Research	V.N. Kalpana Department of Biomedical Sciences, School of Biosciences and Technology, VIT University, Vellore 632014, Tamil Nadu, India	Dr. R. Babujanathanam	Thiruvalluvar University	2017	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5655386/pdf/main.pdf
169	Research	Ahmed Alsaedi, Professor Department of Mathematics Faculty of Sciences King Abdulaziz University, Saudi Arabia.	Dr. R. Samidurai	DST-SERB	2017	Joint Research Publication	http://dx.doi.org/10.1016/j.amc.2016.10.038
170	Research	F. E. Alsaadi Associate Professor, Department of Electrical and Computer Engineering, King Abdulaziz University, Jeddah, Saudi Arabia., E-mail: fuad_alsaadi@yahoo.com.	Dr. R. Samidurai	DST	2017	Joint Research Publication	https://doi.org/10.1016/j.neunet.2016.12.005
171	Research	Quanxin Zhu, School of Mathematical Sciences and Institute of Finance and Statistics, Nanjing Normal University, Nanjing 210023, China	Dr. R. Samidurai	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0096300315008115?via%3Dihub#!
172	Research	R. Raja Ramanujan Centre for Higher Mathematics, Alagappa University, Karaikudi 630004, India	Dr. R. Samidurai	Thiruvalluvar University	2017	Joint Research Publication	https://www.sciencedirect.com/science/article/abs/pii/S0096300315008115?via%3Dihub#!
173	Research	Hemapriya J, Department of Microbiology, DKM College for Women, Vellore, Tamilnadu, 632001, India.	Dr. Vijayanand S	Thiruvalluvar University	2017	Joint Research Publication	https://www.ncbi.nlm.nih.gov/pubmed/28573340
174	Research	Dr. O. M. Kwon Professor, Chungbuk Univeristy South Korea E-mail: madwind@chungbuk.ac.kr	M. Syed Ali	DST-SERB	2017	Joint Research Publication	https://scholar.google.co.in/citations?user=vr3vr8MAAA&hl=en

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
175	Research	Mallavarapu Megharaj View the author's ORCID record Global Centre for Environmental Remediation (GCER), Faculty of Science and Information Technology, The University of Newcastle, University Drive, Callaghan, NSW 2308, Australia	Dr. A. Rajasekar	Thiruvalluvar University	2018	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0045653519302127#!
176	Research	Ramasamy Balagurunathan Department of Microbiology, Periyar University, Salem, 636011, Tamil Nadu, India	Dr. A. Rajasekar	Thiruvalluvar University	2018	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0045653519302127#!
177	Research	Suresh Subashchandrabose Global Centre for Environmental Remediation (GCER), Faculty of Science and Information Technology, The University of Newcastle, University Drive, Callaghan, NSW 2308, Australia	Dr. A. Rajasekar	Thiruvalluvar University	2018	Joint Research Publication	https://www.sciencedirect.com/science/article/pii/S0045653519302127#!
178	Research	Anil Kumar Suresh, Bio-Nanotechnology Laboratory, Department of Biotechnology, Faculty of Science and HumanitiesSRM UniversityChennaiIndia	Dr. J. Madhavan	Thiruvalluvar University	2018	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0768-5
179	Research	Dr. J. Theerthagiri, Scientist C, Centre for Nanoscience and Nanotechnology, Sathyabama University, Chennai.	Dr. J. Madhavan	Sathyabama University, Chennai.	2018	Joint Research Publication	https://www.researchgate.net/scientific-contributions/2032884896_J_Theerthagiri
180	Research	Dr. Junqing Pan, Professor, Beijing Unverstiy of chemical technology beijing, china.	Dr. J. Madhavan	Beijing University of Chemical technology, China.	2018	Joint Research Publication	https://orcid.org/0000-0002-7845-6468
181	Research	Dr. R. A. Senthil, State Key Laboratory of Chemical Resource Engineering, Beijing Advanced Innovation Center for Soft Matter Science and Engineering, Beijing Engineering Center for Hierarchical Catalysts, Beijing University of Chemical technology, China.	Dr. J. Madhavan	Beijing University of Chemical technology, China.	2018	Joint Research Publication	http://en.baicsm.buct.edu.cn/

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Source of financial support	Year of collaboration	Nature of the activity	Link of the relevant document
182	Research	Sreekar Babu Marpu, Department of Chemistry University of North Texas Denton USA.	Dr. J. Madhavan	Thiruvalluvar University	2018	Joint Research Publication	https://link.springer.com/article/10.1007/s11356-017-0768-6
183	Research	A. Vinodhini - Department of Zoology, D.K.M. College for Women, 632 004, Vellore, India	Dr. G. Singaravelu	Thiruvalluvar University	2019	Joint Research	https://app.dimensions.ai/details/publication/pub.1105713060
184	Research	Akon Higuchi - National Central University; RIKEN	Dr. G. Singaravelu	Thiruvalluvar University	2019	Joint Research	https://app.dimensions.ai/details/publication/pub.1105713061
185	Research	V. Kiruthiga - Department of Zoology, D.K.M. College for Women, 632 004, Vellore, India	Dr. G. Singaravelu	Thiruvalluvar University	2019	Joint Research	https://app.dimensions.ai/details/publication/pub.1105713059
186	Research	S. Sharief Basha, Applied Algebra Division, School of Advanced Sciences VIT University Vellore India	Dr. R. Vijayaragavan	Thiruvalluvar University	2019	Joint Research	https://link.springer.com/chapter/10.1007%2F978-3-030-01123-9_60
187	Research	Yang Cao Department of Mechanical Engineering, The University of Hong Kong, Pokfulam, Hong Kong	Dr.R.Samidurai	Thiruvalluvar University	2019	Joint Research	https://www.sciencedirect.com/science/article/abs/pii/S0378475419301120?via%3Dihub#!
188	Research	Prof. Vivekannandan Suresh Kumar Professor, School of Computing and Information System Faculty of Science and Technology, Athabasca University, Canada	Faculties and students	Identification of Potential Collaboration between Thiruvalluvar University, Vellore and Athabasca University, Canada	2019	Joint Research	http://vivek.athabascau.ca/

Decentralized Event-triggered Stability Analysis of Neutral-type BAM Neural Networks with Markovian Jump Parameters and Mixed Time Varying Delays

M. Syed Ali, R. Vadivel, and O. M. Kwon*

ABSTRACT: This paper investigates decentralized event-triggered stability analysis of neutral-type BAM neural networks with Markovian jump parameters and mixed time varying delays. We apply the decentralized event triggered approach to the bidirectional associative memory (BAM) neural networks to reduce the network traffic and the resource of computation. A bidirectional associative memory neural networks is constructed with the mixed time varying delays and Markov process parameters. The criteria for the asymptotically stability are proposed by using with the Lyapunov-Krasovskii functional method, reciprocal convex property and Jensen's inequality. Stability condition of neutral-type BAM neural networks with Markovian jump parameters and mixed delays is established in terms of linear matrix inequalities. Finally three numerical examples are given to demonstrate the effectiveness of the proposed results.

KEYWORDS: BAM Neural networks, event-triggered communication scheme, linear matrix inequality, Lyapunov-Krasovskii functional, Markovian jumping parameters, time varying delay

1. INTRODUCTION

Neural networks have found a large number of successful applications in various fields of science and engineering. The bidirectional associative memory (BAM) neural networks was proposed and researched by Kosko [1, 2], consist of neurons in two layers, the X-layer and the Y-layer. The first layer in the neurons are fully interconnected to the neurons arranged in the second layer, while there are no interconnect among neurons in the same layer [3-5]. Moreover, it is well known that time delays are very important in hardware implementations, because of the finite switching speed of amplifiers or of information processing, and the existence of time delays can lead to oscillation, divergence, and even instability [6-8]. In past years, some quite significant results on parameter uncertainties and neutral-type neural network with time varying delays have been reported [9-12].

When the neural network also incorporates sudden changes in its structure, the Markovian jump linear system is very appropriate to describe its dynamics [13]. This

class of systems is the special class of hybrid systems, which is specified by two components in the particular state. The first one denotes to the mode, which was described by a continuous-time finite-state Markovian process, and the second one denotes to the state which was represented by a system of differential equations. Recently, there has been a growing interest in the study of BAM neural networks with Markovian jump parameters [14-16].

With the high speed development of digital technologies, various number of control methods have been used for find out the stability and controlling the consider neural network [17-19]. In the past few years event-triggered control has been proved to be an efficient way to reduce the transmitted data in the networks, which can relieve the burden of network bandwidth [20, 21]. Nowadays, decentralized event-triggered communication scheme (DETC) attracts renewed consideration due to the presence of reliable wireless network transmission and low cost microprocessors [22-25]. For instance the problem of network-based event-triggered filtering for Markovian jump sys-

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M. Syed Ali and R. Vadivel are with the Department of Mathematics, Thiruvalluvar University, Vellore - 632 115, Tamilnadu, India (e-mail: syedgru@gmail.com, vadivelsr@yahoo.com). O. M. Kwon is with the School of Electrical Engineering, Chungbuk National University, Chungdae-ro 1, Cheongju 28644, Korea (e-mail: maodwin@chungbuk.ac.kr).

* Corresponding author.

Robust H_∞ State-feedback Control for Nonlinear Uncertain Systems with Mixed Time-varying Delays

R. Saravanakumar, M. Syed Ali, He Huang, Jinde Cao, and Young Hoon Joo*

Abstract: This paper presents a new less conservative stability and H_∞ state-feedback controller design of nonlinear uncertain systems with discrete interval and distributed time-varying delays. The main objective of this work is to attain robust asymptotic stability of concerned nonlinear system with H_∞ performance index. By constructing suitable Lyapunov-Krasovskii functional (LKF) with quadruple integral terms, sufficient conditions are obtained for delay-dependent robust H_∞ state-feedback control in the form of linear matrix inequalities (LMIs). Finally, numerical examples are added to show the advantage and usefulness of this work.

Keywords: Distributed delay, interval time-varying delay, Linear matrix inequalities, nonlinear disturbance, robust H_∞ state-feedback control.

1. INTRODUCTION

Over the past twenty years, great research interest has been accumulated to time delay systems because they have been successfully applied in various fields, such as aircraft stabilization, nuclear reactors, ship stabilization, models of lasers and neural networks. Thus the problems of time delay systems have undergone much stability analysis in recent decades [1, 2]. Recently, a new type of time delays, that is, interval time-varying delays, has been frequently confronted from various practical and theoretical systems and has been gathered much attention in the area of time-delay systems [1, 3]. Systems with distributed delays are arisen when the number of summands in a system equation is increased and the differences between neighboring argument values are decreased [4, 5]. It is often applied to the modeling of feeding system and combustion chambers in a liquid mono propellant rocket motor with pressure feeding [1]. The existence of distributed delays in a time-varying delay system may cause the filter design more complicated and difficult to be solved by traditional method.

The control design for uncertain systems with mixed time-varying delays is one of the difficult issue in control theory [6, 7]. Theoretically, this issue possibly solved by Lyapunov method approach. H_∞ performance is generally used to synthesize controllers to ensure stability with guar-

anteed performance in control theory. Stability is a major problem while synthesizing the controller design. Thus, the stability problem and H_∞ control for delayed systems have received significant research interest in the control community [8, 9].

In practice, real systems usually present some uncertainties due to environmental noise and slowly varying parameters, etc. Accordingly, the stability problem of uncertain nonlinear time-varying delay systems has been received considerable attention [10, 11]. To the best of the author's knowledge, H_∞ control of nonlinear uncertain systems with discrete interval and distributed time-varying delays has not yet been fully investigated, which motivates the current study.

From the above statements, we have studied the H_∞ state-feedback control problem for nonlinear uncertain systems with mixed time-varying delays. By using the LKF technique and convexity of some matrix functions, a new method is proposed. Then, the less conservative criteria for the existence of robust H_∞ controller are derived in terms of LMI. At last, numerical examples are given to show the usefulness and superiority of our approach.

2. PROBLEM DESCRIPTION AND PRELIMINARIES

Consider a nonlinear uncertain system:

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R. Saravanakumar and Young Hoon Joo are with the Department of Control and Robotics Engineering, Kunsan National University, Kunsan, Chonbuk 573-701, Korea (e-mails: saravanamaths80@gmail.com, yhjoo@kunsan.ac.kr). M. Syed Ali is with Department of Mathematics, Thanjavur University, Vellure 622115, Tamil Nadu, India (e-mail: syedgra@gmail.com). He Huang is with the School of Electronics and Information Engineering, Soochow University, Suzhou 215006, China (e-mail: hehuang@suda.edu.cn). Jinde Cao is with the Department of Mathematics, Southeast University, Nanjing 210018, China (e-mail: jdcao@seu.edu.cn).

* Corresponding author.



RESEARCH ARTICLE

Airborne bacteria associated with corrosion of mild steel 1010 and aluminum alloy 1100

Aruliah Rajasekar^{1,2} · Wang Xiao¹ · Manivannan Sethuraman^{1,3} ·
Punniyakotti Parthipan² · Punniyakotti Elumalai²

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Abstract A novel approach to measure the contribution of airborne bacteria on corrosion effects of mild steel (MS) and aluminum alloy (AA) as a function of their exposure period, and the atmospheric chemical composition was investigated at an urban industrial coastal site, Singapore. The 16S rRNA and phylogenetic analyses showed that *Firmicutes* are the predominant bacteria detected in AA and MS samples. The dominant bacterial groups identified were *Bacillaceae*, *Staphylococcaceae*, and *Paenibacillaceae*. The growth and proliferation of these bacteria could be due to the presence of humidity and chemical pollutants in the atmosphere, leading to corrosion. Weight loss showed stronger corrosion resistance of AA (1.37 mg/cm²) than MS (26.13 mg/cm²) over the exposure period of 150 days. The higher corrosion rate could be a result of simultaneous action of pollutants and bacterial exopolysaccharides on the metal surfaces. This study demonstrates the significant involvement of

airborne bacteria on atmospheric corrosion of engineering materials.

Keywords Mild steel · Aluminium alloy · Atmospheric corrosion · Biofilm · Microbial community · 16S rRNA analysis

Introduction

Microbiologically influenced corrosion (MIC) is an electrochemical progression in which microorganisms initiate, facilitate, or accelerate the corrosion reaction (Beech 2004; Rajasekar et al. 2010, 2011). From previous studies, it is known that microorganisms tend to append themselves to surfaces exposed to the ambient environment to colonize, proliferate, and form a biofilm (Flemming 1996). The biofilm, consisting of microbial cells and their metabolites as well as extracellular polymeric substance (EPS), creates gradients of pH, dissolved oxygen, nutrient contents, temperature and pressure, leading to MIC of metals and alloys (Sarro et al. 2006; Shear et al. 2011; Narenkumar et al. 2016). The overall economic burden of corrosion amounts to at least 4%–5% of the GNP (Gross National Product), and 20%–25% of this cost has been estimated to be due to the action of microorganisms (Flemming 1996; Koch et al. 2002).

Steel and its alloys are the most commonly employed metallic materials for construction of a wide range of equipment and metallic structures deployed in open-air environments due to their low cost and excellent mechanical strength (Brown and Masters 1982; De la Fuente et al. 2011). Most types of steel are exposed to open-air conditions, habitually in exceedingly polluted atmospheres, where corrosion is much more severe than in clean rural environments. Atmospheric corrosion leads to degradation of structures, devices, and products

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✉ Aruliah Rajasekar
rajasekargood@gmail.com

¹ Department of Civil and Environmental Engineering & Minerals, Metals and Materials Technology Centre (M3TC), Faculty of Engineering, National University of Singapore, Block EA, 9 Engineering Drive 1, Singapore 117576, Singapore

² Present address: Environmental Molecular Microbiology Research Laboratory, Department of Biotechnology, Thiruvalluvar University, Serkkadu, Vellore, Tamil Nadu 632 115, India

³ Present address: Biofouling and Biofilm Processing Section, Water and Steam Chemistry Division, BARC Facilities, Kalpakkam, Tamil Nadu 603 102, India

Exponential dissipativity criteria for generalized BAM neural networks with variable delays

R. Saravanakumar^{1,4} · Grienggrai Rajchakit² · M. Syed Ali³ · Young Hoon Joo⁴

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Abstract This article evaluates the exponential dissipativity and passivity criterions for generalized bidirectional associative memory neural networks (BAMGNNs) including interval time-varying delayed signals. Exponential dissipativity and passivity criterions are proposed by making suitable Lyapunov–Krasovskii functional and proposing a novel approach. The improved reciprocally convex combination and weighted integral inequality techniques are utilized to obtain new exponential dissipativity and passivity conditions of such delayed BAMGNNs. The feasibility of the obtained results is clearly demonstrated by numerical examples.

Keywords Generalized BAM neural network · Exponential stability · Passivity and dissipativity analysis · Time-varying delay · Weighted integral inequality

1 Introduction

Artificial neural networks (NNs) have been successfully studied in the past 2 decades, since they have been applied and extended to numerous engineering systems, such as image processing, communication, fault diagnosis, parallel computations, fixed-point computations, and industrial automation [1]. During the implementation and application of NNs, time-delayed signals are unavoidable because of the inherent finite signal transfer time between the neurons. The existence of time-delayed signals in systems may cause divergence, instability, and the gradual degradation of the system performance. Thus, time-delayed NNs have received a great deal of research attention [2–10]. In previous years, static NNs and local field NNs have been studied separately. To avoid such doubly work, Zhang et al. [11] proposed a new combined NN model named as generalized neural network (GNN), which brings both static and local field NNs together. Recently, a number of stability problems for such GNNs have been investigated in [12–15].

Recently, the dissipativity problem has gained extensive research attention, since it is an important subject for physical systems, such as the design of group coordination, hybrid systems, nonlinear time-delay systems, and Internet-based control [16, 17]. Passivity, and its generalization dissipativity, characterizes the energy consumption of a system and is used in a variety of applications (e.g., electrical, mechanical, chemical, and communication systems). In most cases, passivity can be used to demonstrate that passive systems will be stable under specific criteria [18, 19]. The dissipativity criteria are a more general case of passivity and stability analyses. Thus, it is essential to consider dissipativity problems for NNs.

✉ Young Hoon Joo
yhjoo@kunsan.ac.kr

¹ Department of Mathematics, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400, Thailand

² Department of Mathematics, Faculty of Science, Maejo University, Samsat, Chiang Mai 50290, Thailand

³ Department of Mathematics, Thiruvalluvar University, Vellore, Tamil Nadu 632115, India

⁴ Department of Control and Robotics Engineering, Kunsan National University, Kunsan, Chonbuk 573-701, Republic of Korea



香港浸會大學 高漢林業珠三角環境應用研究中心
Hong Kong Baptist University
Sino-Forest Applied Research Centre for Pearl River Delta Environment

Mr PUNNIYAKOTTI Elumalai
Department of Biotechnology
Thiruvalluvar University
Serkadu, Vellore-632112
Tamil Nadu
India

1 December 2016

Dear Mr. Punniyakotti,

Agreement about the Monthly Financial Allowance

During your study period from 15 December 2016 to 14 June 2017, as a special full time PhD research student in the Sino-Forest Applied Research Centre for Pearl River Delta Environment, Hong Kong Baptist University, you will receive monthly financial allowance HK\$6500 per month.

You will work on various research projects and you need to do both laboratory work and instrumental analysis.

If you agreement with the offer, please sign both copies of the agreement and return one copy to me.

Welcome to our Research Centre!

Prof. Jonathan WONG, Director

Date:

Mr. PUNNIYAKOTTI Elumalai

Date:

VICE-CHANCELLOR



November 4, 2016

Mr PUNNIYAKOTTI Elumalai
Dept. of Biotechnology
Thiruvalluvar University
Serkadu, Vellore-632112
Tamil Nadu
India

Dear Mr PUNNIYAKOTTI,

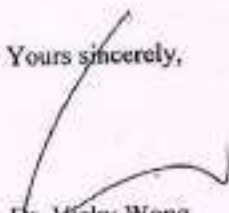
**Application for Admission as
A Special Full-time Research Student**
[Programme Code: VS (PH.D.) RCPE]

I am pleased to inform you that you have been accepted as a special full time PhD research student in the **Sino-Forest Applied Research Centre for Pearl River Delta Environment**. You will be expected to arrive in Hong Kong on or before **January 1, 2017** and report to the Graduate School for registration.

Upon your arrival, please discuss with your Co-supervisor (Prof. Wong Jonathan W C) on an agreed date to commence your studies. The duration of the study period is 6 months, i.e., from January 1, 2017 to June 30, 2017.

Please contact Mr. Lo Kam Fai of the Graduate School for further enquiries [tel: (852) 3411 2214; email: kamfai@hkbu.edu.hk]. We welcome you to our University and wish you all the best in this intellectual pursuit.

Yours sincerely,


Dr. Vicky Wong
Senior Assistant Academic Registrar

Enclosures

VW/CT/FL/pc

cc Prof. Wong Jonathan W C, Director and Co-supervisor, Sino-Forest Applied Research Centre for Pearl River Delta Environment
Student File (Student No. 16554752)



June 6, 2017

Dept. of Biotechnology
Dharmasulvan University
Serkadu, Vellore-632112
Tamil Nadu
India
PUNNIYAKOTI Elumalai

To Whom It May Concern

Dear Sir/Madam,

This is to certify that Mr PUNNIYAKOTI Elumalai (16554752) was enrolled as a visiting PhD student in our Sino-Forest Applied Research Centre for Pearl River Delta Environment from December 16, 2016. His last day of studies is scheduled for June 15, 2017. His performance during the exchange study period has been good.

Thank you.

Yours sincerely,

Dr. Vicky Wong
Senior Assistant Academic Registrar

VW/FL/pc

Bjdy



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New passivity criteria for memristor-based neutral-type stochastic BAM neural networks with mixed time-varying delays

M. Syed Ali^a, R. Saravananakumar^b, Jinde Cao^{a,c}

^a Department of Mathematics, Harbinbin University, 150002, Harbin, Heilongjiang, China

^b Department of Mathematics, Southeast University, Nanjing 210016, China

^c Department of Mathematics, Faculty of Science, King Abdulaziz University, Jeddah 21589, Saudi Arabia



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ABSTRACT

This paper deals with the problem of passivity analysis for a class of memristor-based neutral-type stochastic bidirectional associative memory neural networks (MBSBAMNNs) with discrete internal and distributed time-varying delays. By constructing new Lyapunov–Krasovskii functional (LF) with quadruple integral terms and suitable activation function conditions, some delay-dependent passivity criteria are obtained in the linear matrix inequality (LMI) format. A numerical example is given to demonstrate the effectiveness and superiority of the new scheme.

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1. Introduction

In recent years, the stability analysis of memristor-based neural networks (MNNs) has been greatly focused and has become an emerging area of research due to the fact that it has many successful applications such as image processing, optimization, pattern recognition and other areas [1–3]. Moreover, MNNs are made of hybrid complementary metal oxide semiconductors that have a very wide range of applications in bioinspired engineering [4–6]. MNNs are well suited to characterize the nonvolatile feature of the memory cell because of hysteresis effects. The studies of MNNs would benefit a number of important applications in neural learning circuits [7], associative memories [8], new classes of artificial neural systems [9]. The MNNs are a class of state-dependent nonlinear systems from a systems-theoretic point of view [10–12]. With the development

and application of memristors, the studies of such state-dependent nonlinear systems with its various generalizations have become an active area of research to allow the memristors to be widely used in emerging technologies.

In real nervous networks, synaptic transmission is a noisy process brought on by random fluctuations from the release of neurotransmitters and further probabilistic causes. Therefore, noise cannot be avoided in real applications of artificial neural networks. Practically, there are two main resources that degrade the performance of neural networks that is parameter uncertainties and stochastic perturbation [13–16]. In [17], pth moment exponential stochastic synchronization of coupled MNNs with mixed delays has been studied via delays adaptive control. Synchronization control of stochastic MNNs with mixed delays has been presented in [18].

Bidirectional associative memory neural networks (BAMNNs) or composed of neurons ordered in two layers, *s*-layer and *y*-layer. The neurons in one layer are fully interconnected to the neurons in the other layer [19]. In practical applications, the BAMNNs have been successfully applied to automatic control, pattern recognition, associative memory, image processing, optimization and parallel computation. Thus, many researchers have studied stability properties of the BAMNNs and presented various sufficient conditions for the asymptotic stability [20–22]. More recently, the functional differential inclusions and dynamic behaviors for memristor-based BAMNNs with time-varying delays were investigated in [23].

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* Corresponding address at: Department of Mathematics, Southeast University, Nanjing 210016, China.

E-mail addresses: msyedali@gmail.com (M. Syed Ali), saravananakumar@seu.edu.cn (R. Saravananakumar), jcaoc@seu.edu.cn (J. Cao).


 VICE-CHANCELLOR
 THIRUVALLUVAR UNIVERSITY
 SERKADU, VELLORE - 632 115.



Delay-dependent stability criteria of uncertain Markovian jump neural networks with discrete interval and distributed time-varying delays

M. Syed Ali^{a,*}, Sabri Arık^b, R. Saravanakumar^a

^a Department of Mathematics, Thiuvalluvar University, MG Road 632272, Thiru Vellore, India

^b Department of Computer Engineering, Istanbul University, 34320 Beşiktaş, Istanbul, Turkey

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ABSTRACT

In this paper, a class of uncertain neural networks with discrete interval and distributed time-varying delays and Markovian jumping parameters (MJNs) are carried out. The Markovian jumping parameters are modeled as a continuous-time, finite-state Markov chain. By using the Lyapunov–Krasovskii functional (LKF) and linear matrix inequality technique, some new delay-dependent stability criteria are given to demonstrate the effectiveness of the proposed method. The results are also compared with existing results to show the less conservatism.

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1. Introduction

It is well known that, many kinds of neural networks such as cellular neural networks, Hopfield neural networks, Cohen–Grossberg neural networks, recurrent neural networks (RNNs), complex dynamical networks (CDNs), bidirectional associative memory (BAM) neural networks, chaotic neural networks (CNNs) and state neural networks (SNNs) have been studied, since their extensive applications in different fields such as fault diagnosis, pattern recognition, signal processing and parallel computation [1–5]. Some of these applications require the equilibrium points of the designed network to be stable. Since axonal signal transmission time delays often occur in various neural networks, and they also cause undesirable dynamic network behaviors such as oscillation and instability. Thus it is important to study the stability of neural networks [6–11].

On the other hand Markovian jump neural networks (MJNNs) can be regarded as a special class of hybrid systems, which can model dynamic systems whose structures are subject to random abrupt parameters changes resulting from component or interconnection failures, sudden environment changes, changing subsystem interconnections, and so forth [12–14]. A neural network may

have finite modes, which may jump from one to another at various time. It is shown that such jumping can be determined by Markovian chains [15]. Much work on MJNNs has been reported in the literature [16–19]. A great number of results on the stability and estimation problems related to such neural networks (NNs) have appeared in the recent years [17]. Applications of this kind of neural networks can be found in modeling production system, economic systems, and other practical systems.

The phenomena of time delays are very often encountered in many physical systems, like communication systems, control systems, control systems, drug administration, control of large structural control and systems with lossless transmission lines, (for example see [20–22]). Stability is always required for the real-time applications of neural networks, since their potential application to solve some previously unsolvable problems and improve system performance in many fields such as pattern recognition, fault diagnosis, signal processing and parallel computation. Some of these applications require the equilibrium points of the design network to be stable. Thus stability analysis is one of the fundamental research topics in the study of neural networks. The past decade, lots of research efforts have been devoted to the stability analysis of neural networks with time delays. This is because time delays are unavoidable in neural networks and, too importantly, the existence of time delays often makes a neural network unstable.

In practice, interval time delays exist in biological and artificial neural networks due to the finite conduction speed of neurons and synapses. That is, the range of delay values is an interval for which

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*Corresponding author.

E-mail addresses: syed@maths.tvu.ac.in (M. Syed Ali),

arik@istanbul.edu.tr (S. Arık), saravanakumar@maths.tvu.ac.in (R. Saravanakumar).


VICE-CHANCELLOR
THIRUVALLUVAR UNIVERSITY
SERKADU, VELLORE - 632 115.



Less conservative delay-dependent H_∞ control of uncertain neural networks with discrete interval and distributed time-varying delays

M. Syed Ali^a, R. Saravanakumar^b, Quanxin Zhu^{a,*}

^a Department of Mathematics, Hebei Normal University, Wuliu 052015, Tanggu, Hebei, China

^b School of Mathematical Sciences and Institute of Finance and Statistics, Nanjing Normal University, Nanjing 210023, China



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ABSTRACT

This paper deals with the robust H_∞ control problem for a class of uncertain neural networks with discrete interval and distributed time-varying delays. The main purpose of this paper is to estimate robust asymptotic stability of the given neural network with H_∞ performance analysis by constructing novel Lyapunov–Krasovskii functionals with triple integral terms, several new less conservative delay-dependent stability conditions for H_∞ control are obtained in terms of linear matrix inequalities. Numerical examples are given to illustrate the effectiveness of the proposed theoretical results. The method given in this paper shows less conservative results when comparing with some existing methods.

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1. Introduction

In recent years extensive research goes on delayed neural networks since their potential applications to solve some previously unsolvable problems, and improve system performance in many fields such as pattern recognition, fault diagnosis, signal processing and parallel computation. Some of these applications require the equilibrium points of the designed network to be stable. Thus, the problems of time delay systems have undergone much stability analysis in recent decades [1–12].

Time delay is an interesting feature of signal transmission between neurons, and becomes one of the main sources for causing instability and poor performances of neural networks, see [2–4,12]. According to the way it occurs, time delay can be classified as two-types: discrete and distributed delays. Discrete time-delay is relatively easier to be identified in practice and hence the stability analysis for neural networks with discrete delays has been an attractive subject of research in the past few

years. Neural network usually has a spatial nature due to the presence of various parallel pathways with a variety of axon sizes and lengths, so it is desirable to model them by introducing unbounded delays. Thus, there will be a distribution of conduction velocities along these pathways and a distribution of propagation delays. In these circumstances the signal propagation is not instantaneous and cannot be modeled with discrete delays and a more appropriate way is to incorporate continuously distributed delays in neural network models. For some systems, delay phenomena may not be simply considered as delays in the velocity terms and/or discrete delays in the states. Therefore, it is desirable to extend the system model to include distributed delays. In recent years there has been a growing research interest in study of neural networks with distributed delays [13–15]. In fact, both discrete and distributed delays should be taken into account when modeling a realistic network [16–18]. Recently, a new type of time delays, that is, interval time-varying delays, has been frequently encountered from various practical and theoretical systems and has gathered much attention in the area of time-delay systems [19].

The control design for uncertain neural networks with discrete interval and distributed time-varying delays has been a hard problem of control theory. Stability is one of the most important problem in the synthesis of control systems. H_∞ performance is usually analyzed in control theory to synthesize controllers achieving stabilization with guaranteed performance. Therefore, the problem of delay-dependent stability analysis and H_∞ control for delayed systems has received substantial observations among control community for the last few years [20–22].

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* Corresponding author.

E-mail addresses: zhuqx@hebnu.edu.cn (M. Syed Ali), saravanan@math.nnu.edu.cn (R. Saravanakumar), zhuqx@hebnu.edu.cn (Q. Zhu).

Stability Criteria for Stochastic Takagi-Sugeno Fuzzy Cohen-Grossberg BAM Neural Networks with Mixed Time-Varying Delays

MUHAMMAD SYED ALI,¹ PAGAVATHIGOUNDER BALASUBRAMANIAM,² EATHALLA A. BIRAN,^{3,4} AND SHANMUGAN LAKSHMIDHAN²

¹Department of Mathematics, Thiruvalluvar University, Vellore 630 015, Tamil Nadu, India; ²Department of Mathematics, Anna University, Tamil Nadu, India; ³Department of Mathematical Science, College of Science, UAE University, Al-Ain 15551, UAE; and ⁴Department of Mathematics, Faculty of Science, Helwan University, Cairo 11795, Egypt

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*This article is concerned with the asymptotic stability analysis of Takagi-Sugeno stochastic fuzzy Cohen-Grossberg neural networks with discrete and distributed time-varying delays. Based on the Lyapunov functional and linear matrix inequality (LMI) technique, sufficient conditions are derived to ensure the global convergence of the equilibrium point. The proposed conditions can be checked easily by LMI Control Toolbox in Matlab. It has been shown that the results are less restrictive than previously known criteria. They are obtained under mild conditions, assuming neither differentiability nor strict monotonicity for activation function. Numerical examples are given to demonstrate the effectiveness of our results. © 2014 Wiley Periodicals, Inc. *Complexity* 21: 143–154, 2014*

Key Words: Cohen-Grossberg bidirectional associative memory neural network; global asymptotic stability; linear matrix inequality; Lyapunov functional; stochastic analysis; time-varying delays; T-S fuzzy model

1. INTRODUCTION

During the last decades, artificial neural networks have received considerable attention due to their applications in signal processing, image processing, pattern recognition, control, and optimization. In 1982, Cohen and Grossberg [1] proposed a class of neural networks, which are called now Cohen-Grossberg neural networks

This model has received increasing interest due to its promising potential for applications in classification, parallel computation, associative memory, especially in solving some optimization problems. Such applications rely on the qualitative properties of stability. Therefore, the qualitative analysis is prior condition to develop the application of these dynamical networks. Conversely, the time delay is inevitable in electronic implementation of neural networks due to their finite speed of switching and transmission of signals. Such time delay may cause influence

Correspondence to: Syed Ali, E-mail: syedgato@gmail.com

பட்டியல்

- பகுதி I : "தமிழ்நாட்டின் உருவீழ்வுகள் தொடர்பான கவிதைகள்" -
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 மாண. உ. பி. பி. மாணியர் ஆராய்ச்சி துறையின்
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 மையம்.
- பகுதி II : "மாணியர் சிறப்புகள் மீது உருவீழ்வுகள் தொடர்பான கவிதைகள்"
 முனைவர் S. சிவசுப்பிரமணியன்
 விருது: D பட்டம் தயார் செய்த
 மாண. உ. பி. பி. மாணியர் ஆராய்ச்சி துறையின்
 மத்திய உ. பி. பி. மாணியர்
 மையம்.
- பகுதி III : "உ. பி. பி. மாணியர் தொடர்பான கவிதைகள்"
 திரு. ஏ. சிவசுப்பிரமணியன்
 உ. பி. பி. மாணியர்
 உ. பி. பி. மாணியர் ஆராய்ச்சி துறையின்
 மத்திய உ. பி. பி. மாணியர்
 மையம்.
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 மத்திய உ. பி. பி. மாணியர்
 மையம்.

மேலும்

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 மையம், சென்னை - 600 035. தொடர்பு: 95270145

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 மையம், சென்னை - 600 035.

S. S. S.
 VICE-CHANCELLOR
 THIRUVALLUVAR UNIVERSITY
 SERKADU, VELLORE - 632 115.



Bismuth Oxyiodide Nanoflakes Showed Toxicity Against the Malaria Vector *Anopheles stephensi* and In Vivo Antiplasmodial Activity

Kadarkarai Murugan^{1,2} · Jagannathan Madhavan³ · Christina Mary Samidoss¹ · Chellasamy Panneerselvam⁴ · Al Thabiani Aziz⁵ · Arumugam Malathi³ · Aruliah Rajasekar⁵ · Amuthavalli Pandiyan⁷ · Suresh Kumar⁶ · Abdullah A. Alarfaj⁷ · Akon Higuchi⁸ · Giovanni Benelli^{9,10}

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Abstract

Anopheles stephensi is a mosquito vector of malaria, which is still considered a relevant public health problem due to increasing outdoor transmission, growing resistance to insecticides used to target vectors, and antiplasmodial drugs as well. Thus, there is a vital need to explore novel sources of effective compounds. In this study, the hydrothermal method was used for the synthesis of bismuth oxyiodide (BiOI) nanoflakes. Furthermore, the toxicity of BiOI nanoflakes was evaluated for the first time on *A. stephensi*, as well as in vivo against the malaria parasite *Plasmodium berghei*. The synthesis of BiOI nanoflakes was confirmed by various characterization techniques, including X-ray diffraction, Fourier transform-infrared spectroscopy, field emission scanning electron microscopy and transmission electron microscopy (HR-TEM). LC₅₀ of BiOI nanoflakes on *A. stephensi* were 2.263 ppm (larva I), 3.414 ppm (II), 4.956 ppm (III), 6.983 ppm (IV) and 8.605 ppm (pupae). In vivo antiplasmodial experiments conducted on *P. berghei* infecting albino mice showed 27.2% of chemosuppression after 4 days of treatment with 300 mg/kg/day of BiOI, a lower performance if compared to chloroquine. Overall, our results suggested that hydrothermal synthesis of BiOI nanoflakes may be considered to develop newer and safer tools for malaria vector control.

Keywords Culexidae · Integrated vector management · Mosquito · Nanotechnology · *Plasmodium berghei*

Introduction

Despite a recent decline, the epidemiological burden of malaria persists in sub-Saharan Africa due to several factors, including increasing outdoor transmission as well as

growing resistance to antiplasmodial drugs and insecticides used to target malaria mosquitoes [11, 48, 53, 61]. This is reflected by residual transmission to the vulnerable groups that accounted for 92% of global deaths reported from African region in 2016 [71]. Residual transmission, which is

✉ Kadarkarai Murugan
kavvkg@gmail.com

✉ Giovanni Benelli
benelli.giovanni@gmail.com

¹ Department of Zoology, Bharathiar University,
Coimbatore 641 046, India

² Thiruvalluvar University, Vellore 632 115, India

³ Solar Energy Lab, Department of Chemistry, Thiruvalluvar
University, Vellore 632 115, India

⁴ Department of Biology, Faculty of Science, University of
Tabuk, Tabuk 71491, Saudi Arabia

⁵ Department of Biotechnology, Thiruvalluvar University,
Vellore 632 115, India

⁶ Department of Medical Microbiology and Parasitology,
Universiti Putra Malaysia (UPM), Serdang, Selangor 43400,
Malaysia

⁷ Department of Botany and Microbiology, College of Science,
King Saud University, Riyadh 11451, Saudi Arabia

⁸ Department of Chemical and Materials Engineering, National
Central University, Taoyuan 32001, Taiwan

⁹ Department of Agriculture, Food and Environment,
University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy

¹⁰ The BioRobotics Institute, Scuola Superiore Sant'Anna,
Viale Rinaldo Piaggio 34, 56025 Pontedera, Pisa, Italy

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Sargassum wightii-synthesized ZnO nanoparticles reduce the fitness and reproduction of the malaria vector *Anopheles stephensi* and cotton bollworm *Helicoverpa armigera*

Kadarkarai Murugan, Mathath Roni, Chellasamy Panneerselvam, Al Thabiani Aziz, Udaiyan Suresh, Rajapandian Rajaganesh, Rajasekar Aruliah, Jazem A. Mahyoub, Subrata Trivedi, Hasibur Rehman, Hatem Ahmed Naji Al-Aoh, Suresh Kumar, Akon Higuchi, Baskaralingam Vaseeharan, Hui Wei, Sengottayan Senthil-Nathan, Angelo Canale, Giovanni Benelli

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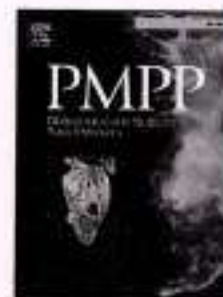
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VICE-CHANCELLOR
THIRUVALUVAR UNIVERSITY
SERKADU, VELLORE - 632 115.



Solution Combustion Synthesis of Hierarchically Structured V_2O_5 Nanoflakes: Efficacy Against *Plasmodium falciparum*, *Plasmodium berghei* and the Malaria Vector *Anopheles stephensi*

Kadarkarai Murugan^{1,2} · Christina Mary Samidoss¹ ·
Jayaraman Theerthagiri³ · Chellasamy Panneerselvam⁴ ·
Jagannathan Madhavan³ · Aruliah Rajasekar⁵ ·
Angelo Canale⁶ · Giovanni Benelli⁶

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Abstract The effective prevention and treatment of malaria still represent a major public health challenge. Here, the solution combustion method was used for the synthesis of hierarchically structured V_2O_5 nanoflakes. The toxicity of V_2O_5 nanoflakes was evaluated on the malaria vector *Anopheles stephensi* and on the malaria parasites *Plasmodium falciparum* and *P. berghei*, relying to in vitro and in vivo assays. V_2O_5 nanoflakes were examined by various techniques, including powder X-ray diffraction, field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDS), and high resolution transmission electron microscopy (HR-TEM). LC_{50} of V_2O_5 nanoflakes against *A. stephensi* larvae and pupae were 1.936 ppm (larva I), 3.606 ppm (II), 4.750 ppm (III), 6.636 ppm (IV), and 8.876 ppm (pupae). Furthermore, the antiplasmodial activity of V_2O_5 nanoflakes was evaluated against chloroquine-resistant (CQ-r) and CQ-sensitive (CQ-s) strains of *P. falciparum*. IC_{50} of V_2O_5 nanoflakes were 84.54 μ g/ml (CQ-s) and 88.17 μ g/ml (CQ-r). In vivo antiplasmodial experiments conducted on *P. berghei* infecting albino mice showed moderate activity of V_2O_5 nanoflakes, if compared to chloroquine. Overall, our results highlighted the promising potential of

✉ Giovanni Benelli
benelli.giovanni@gmail.com

¹ Department of Zoology, Bharathiar University, Coimbatore 641 046, India

² Thiruvalluvar University, Vellore 632 115, India

³ Solar Energy Lab, Department of Chemistry, Thiruvalluvar University, Vellore 632 115, India

⁴ Faculty of Science, Department of Biology, University of Tabuk, Tabuk 71491, Saudi Arabia

⁵ Department of Biotechnology, Thiruvalluvar University, Vellore 632 115, India

⁶ Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy

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VICE-CHANCELLOR
THIRUVALLUVAR UNIVERSITY
SERKADU VELLORE - 632 115

Role of *Bacillus subtilis* and *Pseudomonas aeruginosa* on Corrosion Behaviour of Stainless Steel

Hafiz Zeshan Wadood · Aruliah Rajasekar ·
Yen-Peng Ting · Anjum Nasim Sabari

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Abstract Corrosion behavior of SS304 in minimal salt medium with 1.5% NaCl as a corrosive agent in presence of *Bacillus subtilis* strain S1X and *Pseudomonas aeruginosa* strain ZK has been investigated. Electrochemical techniques such as Tafel polarization and electrochemical impedance spectroscopy with surface analytical techniques like atomic force microscopy, scanning electron microscopy–energy dispersive spectrum analysis and Fourier transform infrared spectroscopy showed that both bacteria inhibit corrosion of SS304 due to the development of a protective biofilm on metal surface. The pH values of bacterial-inoculated systems decreased with increasing incubation time showing the production of some acidic metabolites by bacterial isolates.

Keywords Microbiologically influenced corrosion · Stainless steel 304 · Biofilm · Electrochemical impedance spectroscopy · Tafel polarization

1 Introduction

Corrosion of a material, particularly a metal, is an electrochemical process which shifts an electron from zero-valent metal to an environmental electron acceptor that results in

the decline of metal surface [1–3]. Microorganisms are considered to play an important role in this process, and the phenomenon is termed as microbiologically influenced corrosion (MIC) or biocorrosion. MIC or biocorrosion is a long-lasting problem that affects a diverse range of industries including dentistry, pulp and paper, shipping, gas and petroleum industries, sugar industries [1, 4–7]. Stainless steel 304 (SS 304) is an important alloy because of its mechanical properties and resistance to corrosion. SS304 is widely used in different industries such as in the manufacture of implantable medical devices, power generation plants, food production industry, cooling water systems in industries, nuclear power plants, oil drilling platforms, pulp and paper industries and has some marine applications [8–10]. Stainless steel exhibits resistance to corrosion due to the presence of nickel (Ni), manganese (Mn), chromium (Cr) and perhaps molybdenum (Mo), which are the main alloying metals in its metallurgical formulation. The resistance of stainless steel to corrosion is due to the passivation of its surface which results from the reaction of the alloying elements mentioned above, with oxygen to form a stable oxide film [11, 12]. Despite that passivation, slow corrosion rate and a reduced amount of corrosion products on the surface of SS 304 render this metal vulnerable to biofouling [13, 14]. This passivated surface of stainless steel provides an ideal location for the attachment of microbes and therefore is vulnerable to localized corrosion in the form of pits, under stress or in chloride-containing solutions/medium [15, 16]. All types of stainless steel do not have the same behavior, but generally, stainless steel tends to be deteriorated in the presence of microbial biofilms. For the formation of a mature biofilm, bacterial gene expression is changed which concurrently changes metabolic activities of bacterial cells in their biofilm mode of development. This change in metabolic activities causes corrosion of stainless steel. The process of biocorrosion starts with the develop-

H. Z. Wadood (✉) · A. N. Sabari
Department of Microbiology and Molecular Genetics,
University of the Punjab, Lahore 54590, Pakistan
e-mail: shan_wadood1@yahoo.com; zeshan.wadood@gmail.com

A. Rajasekar
Department of Electrotechnology, Thiruvalluvar University,
Serkkadu, Vellore 622 115, India

A. Rajasekar · Yen-Peng Ting
Department of Chemical and Biomolecular Engineering, National
University of Singapore, Singapore 117576, Singapore

Research Article

Characterization of Corrosive Bacterial Consortia Isolated from Water in a Cooling Tower

Rajasekar Aruliah^{1,2} and Yen-Peng Ting¹

¹ Department of Chemical & Biomolecular Engineering, National University of Singapore, Singapore 117576

² Environmental Molecular Microbiology Lab, Department of Biotechnology, Thiruvalluvar University, Setkkuadi, Vellore 632 015, India

Correspondence should be addressed to Rajasekar Aruliah; rajasekar.aruliah@gmail.com and Yen-Peng Ting; chetyp@nus.edu.sg

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An analysis of a culturable corrosive bacterial community in water samples from a cooling tower was performed using traditional cultivation techniques and its identification based on 16S rRNA gene sequence. Seven aerobic bacterial species were identified: *Pseudomonas putida* ARTYP1, *Pseudomonas aeruginosa* ARTYP2, *Massilia timonae* ARTYP3, *Massilia albidiflava* ARTYP4, *Pseudomonas massili* ARTYP5, *Massilia* sp. ARTYP6, and *Pseudomonas* sp. ARTYP7. Although some of these species have commonly been observed and reported in biocorrosion studies, the genus *Massilia* is identified for the first time in water from a cooling tower. The biocorrosion behaviour of copper metal by the new species *Massilia timonae* ARTYP3 was selected for further investigation using a weight loss method, as well as electrochemical and surface analysis techniques (SEM, AFM, and FTIR). In contrast with an uninoculated system, thin bacterial biofilms and pitting corrosion were observed on the copper metal surface in the presence of *M. timonae*. The use of a biocide, bronopol, inhibited the formation of biofilm and pitting corrosion on the copper metal surface.

1. Introduction

In order to implement efficient monitoring and control strategies for the mitigation of biocorrosion, it is important to have knowledge of the microbial population responsible for this phenomenon, as well as interactions of different microorganisms with metallic surfaces [1–8]. In many industries, cooling towers are commonly used for heat transfer from recirculated water to the atmosphere, typically by means of trickling or spraying the water over a material with high surface area [9]. These towers generally have sizable water reservoirs, with temperature typically maintained between 25°C and 35°C. These conditions provide an ideal environment for microbial growth and propagation [10–13]. Both microbes and the substrates for microbial growth can either be present in the incoming water or be introduced from the atmosphere. Copper and copper alloys, which are used in many cooling tower systems, are known to be susceptible to microbiologically influenced corrosion (MIC) [10, 14]. Corrosion and

its products have a negative impact on heat transfer and can cause a decrease in cooling efficiency of the cooling tower. Organisms responsible for MIC, including bacteria, microalgae and fungi readily attach themselves to the copper surface by excreting extracellular polymeric substances (EPS) to form a slime layer [15–18] and thereby initiate corrosion. A multilayer structure of microorganisms and their EPS have been reported to be entrapped between layers of different inorganic corrosion products on copper-based surfaces after exposure to natural seawater environment [19–24].

Interestingly, many traditional chemicals used water treatment, for example, antiscalants and zinc-based corrosion inhibitors, which are a source of nutrients that accelerate the growth of microbes in cooling towers [25]. Nonetheless, the control of corrosive bacterial fouling can be achieved through the application of effective biocides [26], or nitrate, or nitrite [27–30]. Environmental regulations and the development of water reservoirs in environmentally sensitive areas have spurred the development of easily degradable “green”



November 4, 2016

Mr PUNNIYAKOTTI Elumalai
Dept. of Biotechnology
Thiruvalluvar University
Serkadu, Vellore-632112
Tamil Nadu
India

Dear Mr PUNNIYAKOTTI,

**Application for Admission
A Special Full-time Research Student
[Programme Code VS (PH) (A) (C) (E)]**

I am pleased to inform you that you have been accepted as a special full time PhD research student in the **Sino-Forest Applied Research Centre for Pearl River Delta Environment**. You will be expected to arrive in Hong Kong on or before January 1, 2017 and report to the Graduate School for registration.

Upon your arrival, please discuss with your Co-supervisor (Prof. Wong Jonathan W C) on an agreed date to commence your studies. The duration of the study period is 6 months, i.e., from January 1, 2017 to June 30, 2017.

Please contact Mr. Lo Kam Fai of the Graduate School for further enquiries [tel: (852) 3411 2214; email: kamfai@hkbu.edu.hk]. We welcome you to the University and wish you all the best in this intellectual pursuit.

Sincerely,

Wong
Assistant Academic Registrar

Enclosures

VW/CT/FL/pc

cc Prof. Wong Jonathan W C, Director and Co-supervisor, Sino-Forest Applied Research Centre for Pearl River Delta Environment
Student File (Student No. 16554752)

[Handwritten signature]



November 4, 2016

Mr PUNNIYAKOTTI Elumalai
Dept. of Biotechnology
Thiruvalluvar University
Serkadu, Vellore-632112
Tamil Nadu
India

Dear Mr PUNNIYAKOTTI,

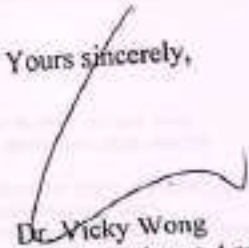
Application for Admission as
A Special Full-time Research Student
[Programme Code: VS (PH.D.) RCPE]

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Yours sincerely,


Dr. Vicky Wong
Senior Assistant Academic Registrar

Enclosures

VW/CT/FL/pc

cc Prof. Wong Jonathan W C, Director and Co-supervisor, Sino-Forest Applied Research Centre for Pearl River Delta Environment
Student File (Student No. 16554752)

International Conference on
Biotechnology for
Waste Conversion
Hong Kong China 2016

CERTIFICATE of AWARD

Sino-Forest Applied Research Centre
for Pearl River Delta Environment

This is to certify that

Dr. Rajasekar Aruliah

has been awarded the "Sino-Forest Applied Research Centre"
Biotechnology for Waste Conversion 2016



Prof Jonathan W C Wong
Director of ARCPE
7th December 2016



香港浸會大學
HONG KONG BAPTIST UNIVERSITY



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VICE-CHANCELLOR
THIRUVALLUVAR UNIVERSITY

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