

Curriculum Vitae

Farid O. Farid

Biographical Data:

Name: Farid O. Farid
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Citizenship: Canadian

Education:

Ph.D. (Mathematics) University of Calgary 1984-1988
Calgary, Alberta, Canada
M.Sc. (Mathematics) University of London 1981-1982
London, England

Web Sites:

<https://www.scopus.com/authid/detail.uri?authorId=8336989600>
<https://www.semanticscholar.org/author/Farid-O.-Farid/71383692?sort=influence>
<http://ronininstitute.org/research-scholars/farid-o-farid/>
<https://www.quora.com/profile/F-Farid-2>
<https://scholar.google.com/citations?user=pXzgqIIAAAAJ&hl=en>
<https://publons.com/researcher/3576243/farid-o-farid/publications/>

- h-index (Scopus Dataset): 8
- h-index (Semantic Scholar): 9
- h-index (Google Scholar): 9

- Projected 2024 h-index (Scopus Dataset): 9

Overview: I am passionate about Math research and the quality of my research work. The relatively low number of publications (20 publications) stems from losing (in total) 5 years to an unsuccessful research problem, and spending 3 additional years (in total) to finish the linear r-fields problem (published in 2008). This paper solved a + 85 year old conjecture. Ten of my 15 top quality research papers are 1-author research articles. Most of my papers are in Q1 journals. I am also a very good teacher, who likes to teach young people about the beauty of Mathematics.

Research Interests: Linear Algebra, Operator Theory and Abstract Algebra. I have published several papers in the following subjects:

- (1) Spectral theory and Perturbation theory of linear operators.
- (2) Inclusion regions for the spectrum of finite and infinite matrices.
- (3) Finite and Infinite Matrices with Variants of the Diagonal Dominance Property (the infinite case is treated by considering the matrix as an operator acting in the sequence space ℓ_p , $p \in [1, \infty]$). Applying the theory to the solutions of linear systems of equations and to the solutions of some differential equations.
- (4) On The Eigenvalues of Quaternion Matrices.
- (5) Systems of quaternion matrix equations.
- (6) The Spectral Variation Problem.
- (7) On The Hermitian Solutions to a System of Adjointable Operator Equations.
- (8) Generalized Inverses of matrices over an arbitrary semi-ring.
- (9) Shift Operators.
- (10) The Numerical Range of Linear Operators and Operator Polynomials.
- (11) Scientometrics.

Research Ranking, a Deeper Look

Important Statistical Information:

- 64% of my publications are in Q1 research journals (Top Quartile Score), and 26% are in Q2 journals (the second best quartile score). (Note that journals are ranked in a decreasing order, in terms of their impact, as Q1, Q2, Q3 and Q4 journals.)
- 58% of my papers in Q1 journals are 1-author papers.
- Only about 11% of research papers world-wide (in all fields combined) now are 1-author papers. So, my 1-author research papers indicate that I am from a distinguished class of researchers.
- The only paper, which appeared in a journal, not indexed by Scopus, was supposed to be published in a Q1 journal, but I withdrew the paper due to persistent mistakes by the referee and being under extreme pressure. (The paper reached “Requiring Minor Revisions” status. Of course, I deeply regret now withdrawing the paper.)

Characterization of My Research Work:

(1) **Research Quality:** The following statements could be easily verified: 12 of my 20 published research papers are in Q1 journals (Top quartile ranking; research journals could be arranged in a decreasing order, in terms of research impact, as Q1, Q2, Q3 and Q4 journals). These 12 research papers are published in the Q1 Research Journals:

“**Linear Algebra and Its Applications**” (9 papers),

“**Canadian Journal of Mathematics**” (1 paper),

“**Proceedings of the American Mathematical Society**” (1 paper)

and

“**Proceedings of The Royal Society of Edinburgh Section A: Mathematics**” (1 paper).

I also have published 4 papers in the journal “**Linear and Multilinear Algebra**” and published 1 paper in the journal “**Positivity**”. Both journals are Q2 journals.

(2) **High Percentage of 1-Author Papers:** This is simply calculated by counting the number of authors in each publication. Seven of my twelve published papers in the Q1 journals are 1-author papers. This is a relatively high percentage (58%) of 1-author papers among research papers in Top Quartile Score. One-Author research papers mean the ability to do independent research.

(3) Substantial Research Papers: My top 5 substantial research papers are listed as follows:

- My 1995 paper in Linear Algebra and Its Applications: I was the first mathematician to provide a complete characterization of diagonally dominant matrices. The paper also dealt with infinite matrices, considered as matrix operators acting in the sequence spaces ℓ_p , $p \in [1, \infty]$. This paper took me 2 years of work to finish.
- My 1992 paper in Linear Algebra and Its Applications: I was one of very few mathematicians who contributed to “The Spectral Variation Problem.” Other mathematicians, who contributed to the problem, are highly regarded mathematicians. The 1992 paper took me 18 months of work to finish.
- My 2008 paper in Linear Algebra and Its Applications: The paper answered positively the conjecture of the continuous deformation of linear r – fields, $r = 2, 3$, on the sphere S^3 into orthonormal linear r – fields through linear r – fields. The conjecture remained unanswered for more than 80 years. The paper took me in total 3 years of work to finish.
- My 2019 paper in Linear Algebra and Its Applications: The paper is my longest 1-author paper; it is 37 pages long. It introduces 3 new classes of matrices with variants of the diagonal dominance property, and studies the relation between the 3 new classes with other classes of matrices with variants of the diagonal dominance property. The paper also has an application to the solution of linear systems of equations.
- My 1998 paper in Linear Algebra and Its Applications: The paper studies inclusion regions for the spectrum of a square matrix of order n . The paper took me 2 years of work to finish.

All the 5 preceding papers are 1-author papers, and all research works are full time research work.

(4) Collaboration with Famous Mathematicians:

- I have one joint paper with K. Varadarajan. The paper has the title: “Isometric Shift Operators on $C(X)$ ”, and it is published in the journal “**Canadian Journal of Mathematics**”. The late Mathematician K. Varadarajan was at one time one of the top 5 researchers in Topology in the whole world. The paper has been cited at least 25 times in research papers.
- I have 5 joint papers with Qing-Wen Wang, who is a famous researcher in Matrix Theory. One of these 5 papers has the co-author Fuzhen Zhang, who is a well-known researcher in Matrix Analysis, and he authored several books in Matrix Theory.
- Two of my joint papers are with P. Lancaster, who is a famous researcher in Matrix Theory, and he published several books in Matrix Theory.

(5) Additional Notable Research Achievements and Recognitions:

- Up to date I have research material composed of more than 360 pages published in well-respected refereed journals.
- I was selected in 2019 to be a **Reviewer for Mathematical Reviews**.
- My joint paper (with Qing-Wen Wang and Fuzhen Zhang) “On The Eigenvalues of Quaternion Matrices” in the journal “**Linear and Multilinear Algebra**” is one of the most read articles on the web site of the journal.

Awards and Research Grants:

- Post-Doctoral Fellow at the University of Toronto (1989-1990).
- Several Graduate Research grants during my Ph.D. program.

Employment Experience:

2019-Present: Independent Scholar in the Ronin Institute for Independent Scholarship.

I am stationed in Canada. The Ronin Institute allows scholars from all over the world to join it.

2014-2018: Visiting Research Scholar in Shanghai University.

I was stationed in Canada all the time; this was a research collaboration position through the Internet.

2011-2014: Adjunct Research Professor in the University of British Columbia, Okanagan.

Sept. 2008-December 2009: Senior Instructor in Thompson Rivers University, Kamloops, BC, Canada.

Teaching 6 courses: Calculus, Precalculus, Finite Math, Differential Equations.

Research: Operator Theory and Linear Algebra.

Aug. 2006-2008: Limited-Term Professor in Concordia University, Montreal.

Courses Taught: Calculus, Linear Algebra, Numerical Analysis and Operations Research.

Aug. 2003-June 2006: Visiting Professor in The University of Toledo, Ohio.

Taught 18 courses: Calculus (17) & Differential Equations (1).

Research: Operator Theory and Linear Algebra.

Aug. 2002-June 2003: Visiting Professor in The University of Minnesota, Morris.

Taught 6 courses in Calculus.

Sept. 2001-May 2002: Visiting Professor in Idaho State University, Idaho.

Taught courses in Calculus and Statistics.

Sept. 2000-June 2001: Visiting Professor in Pacific Lutheran University, WA.

Taught 6 courses: Calculus I (2), Linear Algebra (2), Geometry (1) & Senior Seminar (1).

Sept. 1999-Aug. 2000: Visiting Professor in The University of Cincinnati, Ohio.

Duties: Teaching (Calculus; all levels) and Research (Operator Theory).

May 1993- May 1999: Adjunct Research Professor & Instructor in The University of Calgary, Calgary, Alberta.

Taught 23 courses: All levels of Linear Algebra (6), Complex Analysis (1), Differential Equations (2), Real Analysis (1) & all levels of Calculus (13).

Research: Matrix Analysis and Operator Theory.

Sept. 1992-April 1993: Visiting Assistant Professor in The University of Guelph, Ontario.

Duties: Teaching (Differential Equations & Abstract Algebra) and Research (Operator Theory).

1990-June 1992: Researcher and Instructor in The University of Calgary, Alberta.

Taught 8 courses: Calculus (4), Complex Analysis (1), Differential Equations (1), Linear Algebra (2).

Research: Matrix Analysis and Operator Theory.

1989-1990: Post-Doctoral Fellow in The University of Toronto, Ontario.

Duties: Research (Matrix Analysis) and Teaching (Calculus (2) & Linear Algebra (1)).

1984-1988: Teaching Assistant Instructor in The University of Calgary.

Publications:**In Refereed Journals:**

1. Farid O. Farid, On a new index for research assessment, **Journal of Information Science Theory and Practice**, Vol. 9, No. 3, (2021) 56-75.
<https://doi.org/10.1633/JISTaP.2021.9.3.5>
2. Farid O. Farid, On three classes of matrices with variants of the diagonal dominance property, **Linear Algebra and Its Applications**, Vol. 579, (2019) 382-418.
<https://doi.org/10.1016/j.laa.2019.05.034>
3. Farid O. Farid, Xiang-Rong Nie and Qing-Wen Wang, On the solutions of two systems of quaternion matrix equations, **Linear and Multilinear Algebra**, Vol. 66, No. 12, (2018) 2355-2388.
<https://doi.org/10.1080/03081087.2017.1395388>
4. Farid O. Farid, On Classes of Matrices with Variants of the Diagonal Dominance Property, **Advances in Linear Algebra & Matrix Theory**, Vol. 7 (2017) 37-65.
<https://doi.org/10.4236/alamt.2017.72005>
5. F.O. Farid, Zhuo-Heng He and Qing-Wen Wang, The consistency and the exact solutions to a system of matrix equations, **Linear and Multilinear Algebra**, Vol. 64, No. 11, (2016) 2133-2158.
<https://doi.org/10.1080/03081087.2016.1140717>
6. F.O. Farid, Israr Ali Khan and Qing-Wen Wang, On matrices over an arbitrary semiring and their generalized inverses, **Linear Algebra and Its Applications**, Vol. 439, Issue 7, (2013) 2085-2105.
<https://doi.org/10.1016/j.laa.2013.06.002>
7. F.O. Farid, M.S. Moslehian, Qing-Wen Wang and Zhong-Cheng Wu, On the Hermitian solutions to a system of adjointable operator equations, **Linear Algebra and Its Applications**, Vol. 437, Issue 7, (2012) 1854-1891.
<https://doi.org/10.1016/j.laa.2012.05.012>
8. F.O. Farid, Notes on matrices with diagonally dominant properties, **Linear Algebra and Its Applications**, Vol. 435, Issue 11, (2011) 2793-2812.
<https://doi.org/10.1016/j.laa.2011.04.045>
9. F.O. Farid, Qing-Wen Wang and Fuzhen Zhang, On the eigenvalues of quaternion matrices, **Linear and Multilinear Algebra**, Vol. 59, No. 4, (2011) 451-473.
<https://doi.org/10.1080/03081081003739204>
10. F.O. Farid, On the deformation of linear r – fields, **Linear Algebra and Its Applications**, Vol. 429, Issue 1, (2008) 249-265.
<https://doi.org/10.1016/j.laa.2008.02.018>
11. F.O. Farid, ℓ_p -Diagonally Dominant Symmetric Operators, **Positivity**, Vol. 9, No. 1, (2005) 97-114.
<https://doi.org/10.1007/s11117-003-5371-z>
12. F.O. Farid, On the Numerical Range of Operator Polynomials, **Linear and Multilinear Algebra**, Vol. 50, No. 3, (2002) 222-239.
<https://doi.org/10.1080/03081080290004979>

Publications (Continued):**In Refereed Journals:**

13. F.O. Farid, On a conjecture of Hubner, **Proceedings of the Indian Academy of Sciences: Mathematical Sciences**, Vol. 109, No. 4, (1999) 373-378.

<https://doi.org/10.1007/BF02837995>

14. F.O. Farid, Topics on a Generalization of Gershgorin's Theorem, **Linear Algebra and Its Applications**, Vol. 268, (1998) 91-116.

[https://doi.org/10.1016/S0024-3795\(97\)00030-X](https://doi.org/10.1016/S0024-3795(97)00030-X)

15. F.O. Farid, Criteria for Invertibility of Diagonally Dominant Matrices, **Linear Algebra and Its Applications**, Vol. 215, (1995) 63-93.

[https://doi.org/10.1016/0024-3795\(93\)00072-8](https://doi.org/10.1016/0024-3795(93)00072-8)

16. F.O. Farid and K. Varadarajan, Isometric Shift Operators on $C(X)$, **Canadian Journal of Mathematics**, Vol. 46 (3), (1994) 532-542.

<https://doi.org/10.4153/CJM-1994-028-1>

17. F.O. Farid, The Spectral Variation for Two Matrices with Spectra on Two Intersecting Lines, **Linear Algebra and Its Applications**, Vol. 177, (1992) 251-273.

[https://doi.org/10.1016/0024-3795\(92\)90331-4](https://doi.org/10.1016/0024-3795(92)90331-4)

18. F.O. Farid, Spectral Properties of Perturbed Linear Operators and Their Application to Infinite Matrices, **Proceedings of the American Mathematical Society**, Vol. 112, 4, (1991) 1013-1022.

<https://doi.org/10.1090/S0002-9939-1991-1057943-2>

19. F.O. Farid and P. Lancaster, Spectral Properties of Diagonally Dominant Infinite Matrices. II, **Linear Algebra and Its Applications**, Vol. 143, (1991) 7-17.

[https://doi.org/10.1016/0024-3795\(91\)90003-F](https://doi.org/10.1016/0024-3795(91)90003-F)

20. F.O. Farid and P. Lancaster, Spectral Properties of Diagonally Dominant Infinite Matrices, Part I, **Proc. Roy. Soc. Edinburgh Section A: Mathematics**, Vol. 111, Issue 3-4, (1989) 301-314.

<https://doi.org/10.1017/S0308210500018576>

Submitted for Publication:

21. Farid O. Farid, Singular matrices with variants of the diagonal dominance property (20 single-space pages paper).

22. Farid O. Farid, Positive semidefinite preserving linear maps (12 single-space pages paper).

Publications (Continued):**In Preparation:**

23. Farid O. Farid, Spectral inclusion regions for quaternion matrices.
24. Farid O. Farid, Notes on the spectral boundary problem for quaternion matrices (15 single-space pages paper).
25. Farid O. Farid, Perron type theorem for nonnegative matrices.
26. Farid O. Farid, On the existence of left eigenvalues of a quaternion Matrix.
27. Farid O. Farid, Notes on contractions and their unitary dilations in finite dimensional Hilbert spaces.

Other Publications:

28. F.O. Farid, Solution of Problem 1961, **Crux Mathematicorum**, 21(5), (1995) 175-177.

Courses Taught: I taught a wide range of courses covering many topics of Mathematics and Statistics for about 20 years. The courses include: All levels of Calculus and Linear Algebra; Abstract Algebra; Abstract Geometry; Differential Equations; Finance Mathematics; Graduate level Statistics; Numerical Analysis; Operations Research; Real and Complex Analysis.

Services:

- I served on some committees at The University of British Columbia Okanagan.
- I participated in the Calculus program during my 6 years of work at the University of Calgary.

Supervisory Duties: During the academic year 2000-2001, I organized a Senior Seminar course. One of the students worked on a project on Gershgorin Theory under my supervision and was able to finish the requirements by the end of the year.

Computer Skills and Interests:

- More than 20 years of experience in the use of \LaTeX .
- Good experience in the use of Maple.

Hobbies and Other Information: Music and sports. Fluent in 3 languages.

References

Professor Rajendra Bhatia Ashoka University		rajenbhatia@gmail.com
Professor Qing-Wen Wang Shanghai University	86-21-66132184 86-21-66133781	wqw369@yahoo.com wqwshu9@126.com
Professor Denis White University of Toledo	419-530-2207	dawhite@math.utoledo.edu
Professor Fuzhen Zhang Nova Southeastern University	954-262-8317	zhang@nova.edu

Teaching Philosophy:

I have taught for about 20 years. During these years, I taught a wide range of courses at a variety of levels. The most important aspects of my teaching are:

- 1. Presentation:** I believe in providing a systematic and clear presentation of the material covered during lectures. I spend a good amount of time in preparation for lectures. Most students have described my lectures as well-organized, and have found my writing to be clear. I have a strong command of the English language. During lectures, examples are provided to illustrate the use of theory in solving problems. The amount of theory and proofs depend on the nature and the level of the course at which it is taught.
- 2. Communication and Creating Interest in the Course:** During lectures, I encourage the students to ask questions, and I respond to their questions to the best of my ability. I also engage them in the lectures by posing questions connected to what I am covering during the lecture. I try to create interest in the course by linking theory to applications and showing the need of Mathematics to solve real life problems.
- 3. Availability and Approachability:** I make myself available to answer the students' questions. I provide them with my office hours during the first week of classes, and I tell them that, in case some cannot make it during my office hours, they could also fix appointments with me at a time suitable for both parties. Most students found my answers to their questions to be clear and my arguments to be convincing.
- 4. Supervisory Duties:** During the academic year 2000-2001, I organized a Senior Seminar course. One of the students worked on a project on Gershgorin Theory under my supervision and was able to finish the requirements by the end of the year.

Research Projects:

1 Work Recently Published

(1) **“On three classes of matrices with variants of the diagonal dominance property.”** (37 single-space pages paper.) We introduce three new classes $\mathbf{JGD}(n)$, $\mathbf{LUDD}(n)$ and $\mathbf{DWDD}(n)$ of $n \times n$ complex matrices with variants of the diagonal dominance property. Each of the three classes contains singular matrices. We investigate in depth the relations between the three classes and their relations with the classes of diagonally dominant and generalized diagonally dominant matrices. We also study the problem of providing necessary and sufficient conditions for the singularity of a matrix in each of the three classes $\mathbf{JGD}(n)$, $\mathbf{LUDD}(n)$ and $\mathbf{DWDD}(n)$. We present an application of the theory of the classes $\mathbf{JGD}(n)$, $\mathbf{LUDD}(n)$ and $\mathbf{DWDD}(n)$ to the iterative Jacobi method for the solution of the linear system $Ax = b$.

(2) **“On the solutions of two systems of quaternion matrix equations.”** (joint work with Xiang-Rong Nie and Qing-Wen Wang); **34 single-space pages paper.** We study the system of quaternion generalized Sylvester matrix equations $A_1X + YB_1 = C_1$, $A_2Y + A_3Z = C_2$ and $ZB_2 + WB_3 = C_3$. We establish necessary and sufficient conditions for the system to be solvable, and when such conditions are met, we present the general solution to the system. We also investigate the number of solutions a solvable system could have. Our techniques entail the investigation of the quaternion matrix system $AX = C$ and $YB = D$ in X and Y with the constraint that X and Y have a common submatrix. For such systems, we establish a characterization of solvable systems and provide their general solution. We also study in detail the number of solutions a solvable system could have and present necessary and sufficient conditions for a solvable system to have a unique solution. We finally illustrate our techniques in solving the generalized Sylvester matrix equations by providing an example.

(3) **“On classes of matrices with variants of the diagonal dominance property.”** (29 single-space pages paper.) We study the relations between several classes of matrices with variants of the diagonal dominance property, and identify those classes which form pairs of incomparable classes. For an incomparable pair (X_1, X_2) of classes of matrices with variants of the diagonal dominance property, we also study the problem of providing sufficient conditions for the matrices in X_i to be in X_j with $\{i, j\} = \{1, 2\}$.

(4) **“The consistency and the exact solutions to a system of matrix equations”** (joint work with Zhuo-Heng He and Q.-W. Wang): We establish two techniques for finding necessary and sufficient conditions for the system of matrix equations

$$\begin{aligned} A_i X_i &= C_i, i = 1, \dots, s, \\ D_1 Y &= E_1, Y D_2 = E_2, Y^* = Y, \\ B_i X_i + (B_i X_i)^* + F_i Y F_i^* &= G_i, i = 1, \dots, s, \end{aligned} \tag{1}$$

with s being a positive integer, in the unknowns X_1, \dots, X_s and Y to have a solution. We provide the general solution of a consistent system (1), using each technique. Properties of consistent systems are also considered.

(5) **“On the eigenvalues of quaternion matrices”:** Several results are obtained in this joint paper with Qing-Wen Wang and Fuzhen Zhang; among them Gershgorin type theorems for the right eigenvalues, a counter-example showing the failure to extend Brauer’s theorem for right eigenvalues, Providing sufficient conditions for a complex matrix to have infinitely many left eigenvalues (quaternion scalars), characterization conditions for the left eigenvalues to lie on the Gershgorin spheres in the 2×2 case.

2 Work Submitted, Nearly Finished or in Progress

(1) Farid O. Farid, “On a new measure for research assessment” (15 single-space pages paper).

(2) Farid O. Farid, “Singular matrices with variants of the diagonal dominance property” (20 single-space pages paper).

3 Work in Exploration Stage

On the Existence of Left Eigenvalues of a Quaternion Matrix: Finding a proof for the existence of left eigenvalues for any square matrix with quaternion entries, using techniques in Linear Algebra remains an open question.