
Tomasz F. Stepinski

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EDUCATION

Ph.D., Applied Mathematics, University of Arizona, Tucson, Arizona. 1986

Dissertation topic: *Magnetohydrodynamic Dynamo Action in Disc-Like Astrophysical Bodies*

Magister (Master of Science), Astrophysics, Warsaw University, Poland. 1979

Dissertation topic: *A Model of Light Variations of Be Stars*

PRESENT RESEARCH CONCENTRATION

Machine surveys of landforms on Mars and Earth: machine cataloging of impact craters, automatic mapping of valley networks on Mars and drainage networks on Earth; *terrain analysis, machine learning, mathematical morphology, image processing.*

Automatic generation of thematic maps on Mars and Earth: regional geomorphic mapping of Martian surface; *supervised and unsupervised machine learning, segmentation, classification, normalized mutual information, Kolmogorov complexity.*

Data mining raster datasets in geoscience: discovery of feature-based hot spots in spatial databases; *spatial data mining, spatial collocation.*

PREVIOUS RESEARCH INTEREST

Computational geomorphology: Martian geomorphology; *fractal analysis of drainage basins, cellular models.*

Statistical analysis: extrasolar planets, binaries, Kuiper belt objects.

Models of protoplanetary disks: evolution of solids in protoplanetary disks, architecture and diversity of planetary systems; *numerical solutions of partial differential equations.*

Magnetohydrodynamics: magnetic field generation in accretion disks, angular momentum transport; *numerical solutions of partial differential equations.*

EMPLOYMENT HISTORY

Lunar and Planetary Institute, Houston, TX. <i>Staff Scientist</i>	1990 – present
University of Arizona, Dept. of Planetary Sciences, Tucson, AZ. <i>Research Associate</i>	1986 –1990
University of Arizona, Dept. of Planetary Sciences, Tucson, AZ. <i>Research Assistant</i>	1980 –1986
Copernicus Astronomical Center, Polish Academy of Sciences, Poland. <i>Research Specialist</i>	1979 – 1980

SCHOLARLY & PROFESSIONAL SOCIETES

American Astronomical Society

International Astronomical Union

American Geophysical Union

POSTDOCTORAL FELLOWS AND STUDENTS SUPERVISED

Dr. Erik Urbach Project title: <i>Automatic Identification of Small Craters on Mars from Images using Mathematical Morphology.</i>	2007 - present
Dr. Mauricio Reyes-Ruiz Ph.D. dissertation title: <i>Magnetic Fields in Protoplanetary Disks.</i>	1992-1995
Dimitrios Stamatellos Project title: <i>Infrared Excesses From Accretion Streams in Pre-Main-Sequence Binaries.</i>	1999-2000
William J. O’Hara IV Master dissertation title: <i>Drainage Analysis of Noachian Martian Valley Networks.</i>	2002-2003
Brian Bue Projects title: <i>Automated classification of Landforms on Mars; Automatic Identification of Craters on Mars.</i>	2004-2006
Ian Molloy Project title: <i>Automated Mapping of Valley Networks on Mars.</i>	2004-2005

Soumya Ghosh

2005-2007

Master dissertation title: *A Machine Learning Approach for Automated Geomorphic Map Generation.*

Wei Ding

2007 - present

Project title: *Data Mining Global Datasets on Mars.*

PUBLICATIONS

Recent papers (since 2002)

- T. F. Stepinski, M. P. Mendenhall, and B. D. Bue (2007) Machine Cataloging of Impact Craters on Mars. submitted to Icarus.
- S. Ghosh, T. F. Stepinski, and R. Vilalta (2007) A Framework for Automatic Annotation of Planetary Surfaces with Geomorphic Labels, submitted to Machine Learning Journal.
- T. F. Stepinski, S. Ghosh, and R. Vilalta (2007) Machine Learning for Automatic Mapping of Planetary Surfaces. To appear in proceedings of Nineteenth Innovative Applications of Artificial Intelligence Conference, July 24-26, 2007, Vancouver, British Columbia.
- T. F. Stepinski and E. R. Urbach (2007) Mapping craters depths in Terra Cimmeria, Mars: Implications for spatial distribution of ground ice. 7th International Conference on Mars, July 9-13, Pasadena, California
- B. W. Luo, T. F. Stepinski, and R. Y. Qi (2007) Drainage Density and Controlling Factors in Cascade Range, Oregon, USA. To appear in proceedings of Geoinformatics 2007, May 26-28, 2007, Nanjing, China
- B. I. Molloy and T.F. Stepinski (2007) Automated Mapping of Valley Networks on Mars. Computers and Geoscience, 33, p728-738.
- B. D. Bue and T.F. Stepinski (2007) Machine Detection of Martian Impact Craters from Digital Topography Data. IEEE Transactions on Geoscience and Remote Sensing, 45(1), p.265-274
- R. Vilalta, T.F. Stepinski, and M. Achari (2007) An Efficient Approach to External Cluster Assessment with an Application to Martian Topography. Data Mining and Knowledge Discovery, 14(1), p.1-23.
- T. F. Stepinski, S. Ghosh, and R. Vilalta (2006) Automatic Recognition of Landforms on Mars Using Terrain Segmentation and Classification. In Lecture Notes in Artificial Intelligence, 4265, p 255-266
- W. Luo and T. F. Stepinski (2006) Topographically Derived Maps of Valley Networks and Drainage Density in the Mare Tyrrhenum quadrangle on Mars. Geophysical Research Letters, 33, L18202.
- B. D. Bue and T.F. Stepinski (2006) Automated Classification of Landforms on Mars. Computers and Geoscience, 32, p.604-614.
- T.F. Stepinski and A.P. Stepinski (2005) Morphology of Drainage Basins as an Indicator of Climate on Early Mars. J. Geophys. Res., 110, E12S12.
- T.F. Stepinski and R. Vilalta (2005) Digital Topography Models for Martian Surfaces. IEEE Geoscience and Remote Sensing Letters, 2(3), p.260-264.
- K. Kornet, P. Bodenheimer, M. Rozyczka, T.F. Stepinski (2005) Formation of giant planets in disks with different metallicities. Astronomy & Astrophysics, 430, 1133
- R. Vilalta, T. F. Stepinski, M. Achari, and F. Ocegueda-Hernandez (2004) A Quantification of Cluster Novelty with an Application to Martian Topography. In Lecture Notes in Artificial Intelligence, 3202, p 434-445
- M. Rozyczka, K. Kornet, P. Bodenheimer, T.F. Stepinski (2004) Global evolution of solids in protoplanetary disk: A simple model. Rev. Mexicana de Astronom. Astrofisica, 22, 91.
- T. F. Stepinski and S. Coradetti (2004) Comparing morphologies of drainage basins on Mars and Earth using integral geometry and neural maps. Geophysical Research Letters, 31(15), L15604
- T. F. Stepinski and M. L. Collier (2004) Extraction of Martian Valley Networks from Digital Topography. J. Geophys. Res., 109, E11005
- K. Kornet, M. Rozyczka, T.F. Stepinski (2004) An Alternative look at the Snowline in Protoplanetary Disks. Astronomy & Astrophysics, 417, 151
- T. F. Stepinski, M. L. Collier, P. J. McGovern, S. M. Clifford (2004) Martian Geomorphology from Fractal Analysis of Drainage Networks. J. Geophys. Res., 109, E02995
- T. F. Stepinski, M. M. Marinova, P. J. McGovern, S. M. Clifford (2002) Fractal Analysis of Drainage Basins on Mars. Geophysical Research Letters, 29(8), 30-1.
- M. A. McGrath, E. Nolan, D. C. Black, G. Gatewood, K. Noll, A. Schultz, S. Lubow, I. Han, T. F. Stepinski, T. Targett (2002) An upper limit to the mass of the radial velocity companion to rho Cancri. Astrophysical Journal, 564, L27.

Older papers (before 2002)

- K. Kornet, T. F. Stepinski and M. Rozyczka (2001) Diversity of Planetary Systems from Evolution of Solids in Protoplanetary Disks. *Astronomy & Astrophysics*, 378, 180.
- T. F. Stepinski and D. C. Black (2001) On Orbital Elements of Extrasolar Planetary Candidates and Spectroscopic Binaries. *Astronomy & Astrophysics*, 371, 250.
- T. F. Stepinski, R. Malhotra and D. C. Black (2000) The Upsilon Andromedae System: Models and Stability. *Astrophysical Journal*, 545, 1044.
- T. F. Stepinski and D. C. Black (2000) Statistics of Low-mass companions to Stars: Implications for Their Origin. *Astronomy & Astrophysics*, 356, 903.
- D. C. Black and T. F. Stepinski (2000) On the Nature and Origin of Low-mass Companions to Stars: A Statistical Perspective. In *From Giant Planets to Cool Stars*, ASP Conference Series, Vol 212. (C. Griffith and M. Marley Eds.), 54.
- T. F. Stepinski and D. C. Black (2000) Populational Similarities Between Low-mass and Stellar Companions to Solar-type Stars. In *Birth and Evolution of Binary Stars*, poster proceedings of IAU Symposium 200 (B. Reipurth and H. Zinnicker Eds.), p 167.
- M. Reyes-Ruiz and T. F. Stepinski (1999) An $\alpha\Omega$ -Dynamo in Accretion Disks with Force-free Coronae. *Astronomy & Astrophysics*, 342, 892.
- T. F. Stepinski (1998) New Approach to Diagnosing properties of Protoplanetary Disks. *Astrophysical Journal*, 507, 361.
- T. F. Stepinski (1998) The solar nebula as a process – an analytic model. *Icarus*, 132, 100.
- T. F. Stepinski (1998) Evolving protoplanetary disks: Linking theory to observations. In *Planetary systems: the long view* (L. M. Celnikier and J. Tran Thanh Van Eds.) p. 59. Editions Frontiers.
- P. Valageas and T. F. Stepinski (1998) Evolution of solids in turbulent protoplanetary disks. In *Planetary systems: the long view* (L. M. Celnikier and J. Tran Thanh Van Eds.) p. 59. Editions Frontiers.
- T. F. Stepinski and Valageas P. (1997) Global evolution of solid matter in turbulent protoplanetary disk II. Development of Icy Planetesimals. *Astronomy & Astrophysics*, 319, 1007
- M. Reyes-Ruiz and T. F. Stepinski (1997) Accretion Discs Dynamos in the Presence of an External Magnetic Field. *Monthly Notices of the Royal Astronomical Society*, 285, 501
- M. Reyes-Ruiz and T. F. Stepinski (1996) Axisymmetric Two-Dimensional Computation of Magnetic Field Dragging in Accretion Disks. *Astrophysical Journal*, 459, 653
- T. F. Stepinski and Valageas P. (1996) Global evolution of solid matter in turbulent protoplanetary disk I. Aerodynamics of solid particles. *Astronomy & Astrophysics*, 309, 301.
- T. F. Stepinski and Valageas P. (1996) The global perspective on the evolution of solids in a protoplanetary disk. In *From Dust to Planetesimals: Contributed Papers* (M. E. Kress et al. Eds.) p. 187. NASA Conference Publication 3343.
- G. Rudiger, D. Elstner, and T. F. Stepinski (1995) The Standard Accretion Disk Dynamo. *Astronomy & Astrophysics*, 298, 934
- M. Reyes-Ruiz and T. F. Stepinski (1995) Evolution of Magnetized Protoplanetary Disks. *The Astrophysical Journal*, 438, 750.
- T. F. Stepinski and M. Reyes-Ruiz (1995) Magnetically-Aided Evolution of Protoplanetary Disks. In *Circumstellar Matter 1994* (G.D. Watt and P.M. Williams Eds.) p. 565. Kluwer Academic Publishers.
- T. F. Stepinski (1995) Character and Evolution of Magnetic Fields in Protoplanetary Disks *Revista Mexicana de Astronomia y Astrofisica (Serie de Conferencias)*, 1, 267.
- M. Reyes-Ruiz and T. F. Stepinski (1995) Can α -Disks Drive Winds Centrifugally *Revista Mexicana de Astronomia y Astrofisica (Serie de Conferencias)*, 3, 97
- A. Z. Dolginov and T. F. Stepinski (1994) Are Cosmic Rays Effective for Ionization of Protoplanetary Disks? *The Astrophysical Journal* 427, 377
- A. Z. Dolginov and T. F. Stepinski (1993) On Quasiperiodic Variation of Pulsars' Periods: An Alternative to the Planetary Interpretation of PSR1257+12, in *Planets Around Pulsars*, (J.A. Phillips, S.E. Thorsett, and S.R. Kulkarni, Eds.), p61. Astronomical Society of Pacific.
- T. F. Stepinski (1993) On Magnetic Dynamo in Thin Accretion Disks Around Compact and Young Stars. In *Solar and Planetary Dynamos* (M.R.E. Proctor et al. Eds.) p. 287. Cambridge University Press.
- T. F. Stepinski (1993) Kinematic Dynamo in Turbulent Circumstellar Disks. In *The Cosmic Dynamo* (F. Krause et al. Eds.) p. 203. Kluwer Academic Publishers.
- T. F. Stepinski, M. Reyes-Ruiz, and H.A.T. Vanhala (1993) Solar nebula Magnetohydrodynamic Dynamos: Kinematic Theory, Dynamical Constraints, and Magnetic Transport of Angular Momentum. *Icarus*, 106, 77.
- T. F. Stepinski (1992) Precesja - Tak! Planety - Nie!, *Postepy Astronomii*, 40, p58. (in Polish)
- T. F. Stepinski (1992) Generation of Dynamo Magnetic Fields in the Primordial Solar Nebula, *Icarus*, 97, p130.
- W. R. Stoeger, A. G. Pacholczyk, and T. F. Stepinski (1992) Active Galactic Nuclei. IV. Supplying Black Hole Clusters by Tidal Disruption and by Tidal Capture of Stars. *The Astrophysical Journal*, 391, p550.
- W. R. Stoeger, A. G. Pacholczyk, and T. F. Stepinski (1992) On the Luminosity of a Black Hole Model of Active Galactic Nuclei. *AIP Conference Proceedings 254: Testing the AGN Paradigm*, (S.S. Holt, S.G. Neff, and C.M. Urry, Eds.), p61.
- T. F. Stepinski (1991) Dynamo Magnetic Field Generation in Turbulent Accretion Disks. *Publication of the Astronomical Society of the Pacific*, 103, p777.
- T. F. Stepinski and E. H. Levy (1991), Dynamo Magnetic Field Modes in Thin Astrophysical Disks: An Adiabatic Computational Approximation, *The Astrophysical Journal*, 379, p343.
- T. F. Stepinski and E. H. Levy (1990), Generation of Dynamo Magnetic Fields in Thin Keplerian Disks, *The Astrophysical Journal*, 362, p318.

- T. F. Stepinski and E. H. Levy (1990), Dynamo - Magnetic - Field Induced Angular Momentum Transport in Protostellar Nebulae: The Minimum Mass Protosolar Nebulae. *The Astrophysical Journal*, 350, p819.
- A. G. Pacholczyk, T. F. Stepinski, and W. R. Stoeger (1989), Active Galactic Nuclei. III. Accretion Flow Regimes in an Externally Supplied Cluster of Black Holes. *The Astrophysical Journal*, 343, p563.
- T. F. Stepinski and E. H. Levy (1988), Generation of Dynamo Magnetic Fields in Protoplanetary and Other Astrophysical Disks, *The Astrophysical Journal*, 331, p416.
- A. G. Pacholczyk and T. F. Stepinski (1988), Active Galactic Nuclei. II. Acceleration of Relativistic Particles in a Cluster of Accreting Black Holes, *The Astrophysical Journal*, 324, p695.
- T. F. Stepinski (1980), A Model of Light Variation of Be Stars. *Acta Astronomica*, Vol.30, No4, p413

Lunar and Planetary Science Conference (LPSC) abstracts

- T. F. Stepinski, W. Luo, and Y. Qi (2007) Precision Mapping of Valley Networks in Margaritifer Sinus, Mars. In *Lunar and Planetary Science XXXVIII*, Abstract # 1205
- Ghosh, S., T. F. Stepinski, and R. Vilalta (2007) Automatic Mapping of Martian Landforms Using Segmentation-based Classification. In *Lunar and Planetary Science XXXVIII*, Abstract # 1200
- T. F. Stepinski, M. P. Mendenhall, and B. D. Bue (2007) Robust Automated Identification of Martian Impact Craters. In *Lunar and Planetary Science XXXVIII*, Abstract # 1202
- H. Gregoire-Mazzocco, T. F. Stepinski, P.J. McGovern, S. Lanzoni, A.Frascati, and A. Rinaldo (2006) Martian Meanders: Wavelength-Width Scaling and Flow Duration. In *Lunar and Planetary Science XXXVII*, Abstract # 1185
- T. F. Stepinski, M. Carriere, and I. Molloy (2006) Properties of Martian Highlands Drainage from THEMIS Images and MOLA Topography. In *Lunar and Planetary Science XXXVII*, Abstract # 1118.
- I. Molloy and T.F. Stepinski (2006) Automated Mapping of Valley Networks on Mars. In *Lunar and Planetary Science XXXVII*, Abstract # 1743.
- B. D. Bue and T.F. Stepinski (2006) Machine Detection of Martian Craters from Digital Topography. In *Lunar and Planetary Science XXXVII*, Abstract # 1178.
- T. F. Stepinski and A. P. Stepinski (2005) Inferring Early Mars Climate from Comparison of Drainage Basins' Morphologies on Mars and Earth. In *Lunar and Planetary Science XXXVI*, Abstract # 1392.
- B. D. Bue and T. F. Stepinski (2005) Automated Classification of Landforms in Terra Cimmeria, Mars. In *Lunar and Planetary Science XXXVI*, Abstract # 1195.
- R. Vilalta and T. F. Stepinski (2004) Thematic Maps of Martian Topography Generated by a Clustering Algorithm. In *Lunar and Planetary Science XXXV*, Abstract # 1169.
- T. F. Stepinski and S. Coradetti (2004) Systematic Differences in Topography of Martian and Terrestrial Drainage Basins. In *Lunar and Planetary Science XXXV*, Abstract # 1166.
- T. F. Stepinski and M. L. Collier (2004) Computational Analysis of Drainage Basins on Mars: Appraising the Drainage Density. In *Lunar and Planetary Science XXXV*, Abstract # 1168.
- T. F. Stepinski, R. Vilalta, M. Achari, P. J. McGovern (2003) Algorithmic Classification of Drainage Networks on Mars and its Relation to Martian Geological Units. In *Lunar and Planetary Science XXXIV*, Abstract # 1653.
- M. L. Collier, T. F. Stepinski, P. J. McGovern, S. M. Clifford (2003) Martian Geomorphology from Fractal Analysis of Drainage Networks. In *Lunar and Planetary Science XXXIV*, Abstract # 1642.
- T. F. Stepinski and W. J. O'Hara IV (2003) Vertical Analysis of Martian Drainage Basins. In *Lunar and Planetary Science XXXIV*, Abstract # 1659.
- T. F. Stepinski (1991) Dynamo Magnetic Field Generation in the Solar Nebula, *Lunar and Planetary Science XXII*, p1327.
- T. F. Stepinski (1991) Ionization State and Magnetic Fields in the Solar Nebula, *Lunar and Planetary Science XXII*, p1329.
- T. F. Stepinski (1992) Criteria for Magnetic Field Regeneration in Accretion Disks Models of the Solar Nebula, *Lunar and Planetary Science XXIII*, p1359.
- T. F. Stepinski and H. H. Levy (1992) On the Generation of Magnetic Fields in the Solar Nebula at the Location of the Present-Day Asteroid Belt, *Lunar and Planetary Science XXIII*, p1361.
- A. Z. Dolginov and T. F. Stepinski (1993) Are Cosmic Rays Effective for Ionization of the Solar Nebula, *Lunar and Planetary Science XXIV*, p415.
- T. F. Stepinski and M. Reyes-Ruiz (1993) Magnetically Controlled Solar Nebula, *Lunar and Planetary Science XXIV*, p1351.
- M. Reyes-Ruiz and T. F. Stepinski (1994) The Dynamical Evolution of Magnetized Solar Nebula, *Lunar and Planetary Science XXV*, p1123.
- T. F. Stepinski and P. Valageas (1995) Global Evolution of Solids in Viscous Protoplanetary Disks, *Lunar and Planetary Science XXVI*, p1357.
- T. F. Stepinski and P. Valageas (1996) From Dust to Planetesimals: Global Evolution of Ice in the Solar Nebula, *Lunar and Planetary Science XXVII*, p1269.
- T. F. Stepinski (1997) Modeling the Evolutionary History of the Solar Nebula, *Lunar and Planetary Science XXVIII*, p1373.
- T. F. Stepinski (1998) Diagnosing Properties of Protoplanetary Disks from their Evolution, *Lunar and Planetary Science XXIX*.
- T. F. Stepinski (1999) Layered Accretion in the Solar Nebula, *Lunar and Planetary Science XXX*.

- T. F. Stepinski and D. C. Black (2000) Statistical Similarities Between Populations of “Extrasolar Planets” and Stellar Companions, Lunar and Planetary Science XXXI.
- K. Kornei, T. F. Stepinski and M. Rozyczka (2001) Diversity of Planetary Systems from Evolution of Solids in Protoplanetary Disks, Lunar and Planetary Science XXXII, Abstract # 1612.

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