

Michael D. Doyle, Ph.D.

PROFILE

Scientist, educator, and inventor. Visionary, leader, innovator, planner, facilitator, collaborator, developer, and advocate in biomedical sciences education technologies, remote learning, spatial biology, and biological computing

EDUCATION

University of Illinois at Urbana-Champaign

1991

Ph.D.: Cell & Structural Biology

- Taught human gross anatomy and medical histology in the UIUC College of Medicine
- Student Chapter President and Co-Founder, ACM SIGBIO — Special Interest Group for Biological Computing
- Procter and Gamble Fellowship in Cell Biology
- NIH National Research Service Award, Cell and Molecular Biology Training Program
- Francis and Harlie M. Clark Research Support Award
- University of Illinois Research Fellowship

PROFESSIONAL EXPERIENCE

New Mexico Tech

2023-Present

Vice President for Research and Economic Development and Professor of Biology

- Oversees the Research Division's current external funding portfolio of approximately \$323 million and FY2024 annual research expenditures exceeding \$130 million
- Identifies emerging research opportunities, and mentors new faculty members with their research programs
- Acts as an external advocate for New Mexico Tech's research activities
- Oversees the university's efforts in IP protection, technology transfer, and commercialization

Eolas Technologies Inc.

1994–Present

Founder and Chairman (CEO 1994-2005, CTO 2005-2022)

- Pioneered the field of Spatial biology as lead of the group that created the first system for Spatial Transcriptomics
- Designed and produced online educational technology products for the anatomical sciences
- PI, Co-PI & Chief Scientist on multiple NIH grants/contracts for advanced research in biological computing
- Led the development of the technologies fundamental to the Cloud, blockchain, and mobile intelligent assistants
- Sole inventor or co-inventor on over 27 patents
- Generated over \$250 million dollars in research revenue, producing over \$50 million in proceeds for UCSF

University of California, San Francisco

1993–1994

Director, UCSF Center for Knowledge Management

- Taught medical histology in the UCSF Department of Anatomy
- Led the creation of anatomy educational technology resources for the UCSF Medical Center campus community
- Served on the oversight committee for the Visible Human Project at the National Library of Medicine
- Managed the Computing and Communication Services Div. and the UCSF Innovative Software Systems Group
- Led the team that created and demoed the first Web cloud technology at Xerox PARC in Nov. 1993
- Spun off the Eolas start-up company to assist the University of California in commercializing the related patents

University of Illinois Chicago

1989–1993

Director, UIC Biomedical Visualization Laboratory

- Taught multiple courses in biomedical visualization, and medical histology
- Managed campus-resource interdisciplinary research lab focused on visualization and modeling of biomedical phenomena
- Research on online educational software, high-performance computing, image informatics, and 4D quantitative analysis of biomedical subjects

Michael D Doyle, PhD
Summary of Research Accomplishments

Spatial Biology

Lead inventor on the team that created the first system for spatial transcriptomics in 2000. As the related U.S. patent specification (7,613,571) states, this system solved the need "to gather gene expression data in a manner that supports the type of exploratory research that can take advantage of the broad-spectrum types of biologic activity analysis enabled by today's microarray tools," as well as the need for "technology to allow the collection of large volumes of these types of data, to enable exploratory investigations into patterns of biologic activity ... to correlate gene expression data with morphological structure in a useful and easy to understand manner, such as in a volume visualization environment ... to allow the collection of larger volumes of gene expression data across a wider spectrum of gene types than ever before." Spatial transcriptomics was named the "Method of the Year for 2020" by Nature Methods, in January, 2021. (<https://www.tandfonline.com/doi/full/10.2144/btn-2023-0093>) Based on this work Dr. Doyle and two of his co-inventors were included in the "2021 October Madness Sweet 16" by Sigma Xi, the Scientific Research Society, listing Sigma Xi's prediction of the 16 most likely individual or group candidates to win the 2021 Nobel Prize in Physiology or Medicine. (<https://www.sigmaxi.org/news/keyed-in/post/keyed-in/2021/09/14/2021-october-madness-sweet-16>)

Visible Embryo Project

Founder and Principal Investigator of a multi-institutional, multi-grant, long-term effort to establish an online computational metacenter to support the application of networking and information technologies to the study of early development and morphogenesis. Since its origin in 1992, this project has spawned numerous affiliated research projects over the subsequent decades. Since 2008, the patents resulting from this research initiative have generated over \$250,000,000.00 in license royalties, producing over \$50 million in research revenue for the University of California System. (https://en.wikipedia.org/wiki/Visible_Embryo_Project)

Fractal Analysis of Bone Development

Pioneered the use of fractal analysis for the study of bone development in dental research, in 1989. Created a system for the non- traumatic and non-invasive quantification of trabecular bone density in the mandible using standard dental radiographs. Binary images of trabecular bone patterns, derived from digitized radiographic images, were processed and subjected to fractal analysis to calculate the Hausdorff dimension (D) of the binary image patterns, to establish normal and abnormal ranges for the value of D, allowing early detection of osteopenia from routine dental X-rays.

Cloud Computing

Lead inventor on the team that created the first Web-based cloud-computing platform, in 1993. This technology is widely used to deliver interactive content over the Web, transforming the Web into an application platform of unlimited potential. A user's personal computer is able to tap into powerful remote computers without having to download large amounts of data to their local machine. The applications in part run remotely and the user interacts with the application data as if on their personal computer. Today, this powerful tool is popularly referred to as "The Cloud," and is used to deliver interactive content over the Web for billions of users every day. (<https://iomas.org/timeline.html>)

Code Signing

Sole inventor of the first system to implement code signing, a feature of the Eolas WebWish Web-app browser plug-in, which enabled the use of public-key cryptography to sign downloadable Web app program code using a secret key, so the browser plug-in could then use the corresponding public key to authenticate the code before allowing it access to the plug-in code interpreter's APIs. Over the subsequent 25+ years, code signing has become the worldwide defacto standard for securing downloadable executable Web content. (https://en.wikipedia.org/wiki/Code_signing)

Transient-Key Cryptography

Sole inventor, in 1997, of transient-key cryptography, the immediate technological ancestor of the Bitcoin blockchain system. Now a part of the X.9.95 ANSI National Standard for secure financial timestamps, this technology uses concepts such as transient secret cryptographic keys, forward-signature distributed blockchains, and cross-certification chains to provide a system for irrefutably certifying the time and state of any digital data, without the need for a third-party certificate authority, and was the first example of a blockchain system. (https://en.wikipedia.org/wiki/Transient-key_cryptography)

Mobile AI

Co-inventor of the Skybot mobile intelligent assistant system in 2005, which pioneered the artificially-intelligent mobile assistant product category that is now ubiquitous worldwide. (<https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/9100465>)

Michael D. Doyle, Ph.D. -- Expanded CV

Education

- Ph.D. in Biology, 1991, Department of Cell and Structural Biology, School of Life Sciences, University of Illinois at Urbana-Champaign — focus on microvascular research and computational biology using quantitative image analysis and morphometrics
- Bachelor of Science, 1983, Department of Biocommunication Arts, University of Illinois at Chicago, Health Sciences Center — focus on health-educational media design, biomedical imaging and video production

Employment

Academic

- Vice President for Research and Economic Development, 2023-present, Professor of Biology, 2024-present, New Mexico Tech (<https://NMT.edu/research>), Socorro, NM
- Founder, 2015-2016, CodeAbode Mobile App Coding Bootcamp, Chicago, IL
- Adjunct Professor, 2000-2005, Biomedical Informatics, Dept. of Computer Science, DePaul University, Chicago, IL
- Adj. Professor, 1999-2003, Inst. for Informatics and Computer Sci, George Mason University, Fairfax, VA
- Director, Center for Knowledge Management, 1993 - 1994, (the UCSF Academic Computing Center), University of California, San Francisco, CA
- Asst. Adjunct Professor, 1994 - 1997 Department of Anatomy, School of Medicine, University of California, San Francisco, CA
- Director, Biomedical Visualization Laboratory, 1990 - 1993, University of Illinois at Chicago, Chicago, IL
- Assistant Professor, 1989 - 1993, Department of Biomedical Visualization, College of Associated Health Professions, University of Illinois at Chicago, IL

Business

- Chairman, 1994-present, CTO, 2013-2023, CEO, 1994-2007, Eolas Technologies Inc., Tyler, TX, <https://iomas.org>
- CFO & Co-Founder, 2010-present, Iconicast LLC, Wheaton, IL
- Founder & Manager, 1994-present, Falcon Interactive Online Systems LLC, Wheaton, IL
- Director, Keepsayk LLC, 2011-present, Chicago, IL
- CEO, Iomas Research LLC, 2007-2013, a subsidiary of Eolas Technologies Inc., Wheaton, IL
- Chairman, 1999-2005, Eolas Development Corporation, Chicago, IL
- Chairman & Co-Founder, 2000-2002, ProofSpace Incorporated, Chicago, IL
- Vice President for Research and Development, 1993-1999, MuriTech Incorporated, Cambridge, MA

Volunteer Experience

- UIC Department of Biomedical and Health Information Sciences (2013-present): Advisory Committee
- National Museum of Health + Medicine Chicago (2010-Present): Founder, Chairman and Acting President
- Buonacorsi Foundation (2010-Present): Founder and Chairman
- Beloit College (2014-2020): Member, Board of Trustees
- UIC College of Applied Health Sciences (2014-2019): College Advisory Council
- NIH Div. of Research Grants (1993-2001): Special Study Section 9: Computer Applications in Biology and Medicine
- IEEE National (2000): Chairman, Medical Technology Policy Committee
- NIH National Library of Medicine (1991-1994): The Visible Human Project, Scientific Advisory Board

Professional Societies

- IEEE Engineering in Medicine & Biology Society, 1992-present
- Association for Computing Machinery, UIUC Chapter: Student Chapter President, Special Interest Group for Biological Computing, (SIGBIO), 1988, 1989, lifetime Pioneer Member ACM national: 1991-present
- Association of University Technology Managers (AUTM.org), 2019-present
- American Association for Anatomy, 1986-present
- Sigma Xi, 1987-present; Phi Kappa Phi, 1987-present
- International Society of Lymphology, 1990-1997
- Healthcare Information and Management Systems Society, 1992-1998
- SPIE - The International Society for Optical Engineering, 1989- 1998

Selected Honors and Awards

- Distinguished Alumni Achievement Award, College of Applied Health Sciences, UIC, 2013
- Award for Excellence in Business, St. Ignatius College Prep, 2012
- Procter and Gamble Fellowship in Cell Biology, 1988-1989
- National Research Service Award, Cell and Molecular Biology Training Program of the National Institutes of Health, University of Illinois at Urbana-Champaign, 1987-1988
- Francis and Harlie M. Clark Research Support Award, University of Illinois, 1987
- University of Illinois Research Fellowship, 1987

Selected Committee and Board Memberships

- Board of Directors , New Mexico Consortium (newmexicoconsortium.org) , Chairman 12/2023-12/2025, 2023-present
- Board of Directors, Research Park Corporation, New Mexico Institute of Mining and Technology, Vice President, 2023-present
- State Committee, New Mexico EPSCoR, National Science Foundation, 2023-present
- TEF Review Committee, Technology Enhancement Fund, New Mexico State Higher Ed. Dept, 2023-present
- Editorial Board, Blockchain in Healthcare Today (blockchainhealthcaretoday.com), 2022-present
- External Advisory Board, Tech Innovation Translation Acceleration Grant Program, New Jersey Institute of Technology, 2022-present
- Advisory Committee, Department of Biomedical and Health Information Sciences, UIC, 2013-present
- Board of Trustees: Beloit College, Beloit, WI, 2014-2020
- Advisory Council, College of Applied Health Sciences, UIC, 2014-2019
- NIH Special Emphasis Panel: Computer Applications in Biology and Medicine (SSS-9), Division of Research Grants, National Institutes of Health, 1993-2001
- IEEE National: Medical Technology Policy Committee, 2000
- Scientific Advisory Board: The Visible Human Project, National Library of Medicine, National Institutes of Health, 1991-1994 (http://www.nlm.nih.gov/research/visible/visible_human.html)
- Heads of Information Systems Committee, University of California System, 1993-1994
- Executive Committee: Integrated Advanced Information Management Systems (IAIMS), University of California, San Francisco, 1993-1994
- Curriculum Committee, College of Medicine, University of Illinois at Urbana-Champaign, 1986-1988

Selected Research Grants and Contracts

Principal Investigator: New Mexico Spatial Biology ENGINE, NSF ENGINES grant, \$160,000,000 over 10 years, pending review

The New Mexico Spatial Biology ENGINE (NMSBE) is poised to lead a transformative era in Spatial Biology and Multi-Omics research. It is a collaboration between New Mexico Tech, the National Center for Genome Resources, the University of New Mexico, New Mexico State University, Los Alamos National Laboratory, and Emory University. With a profound understanding that the spatial intricacies of life hide answers to many of biology's deepest questions, NMSBE envisions itself as a beacon that will not only enlighten major problem areas in both plant and animal biology but also will galvanize an entire generation to explore the untapped horizons of spatial analysis of biological systems, while creating workforce development pipelines for under-represented populations, and an economic development engine for the entire region. By offering unprecedented insights into cellular function and disease mechanisms, our vision is to be a cornerstone of innovation, leading the global march toward new realms of discovery in Spatial Biology.

Co-PI: NSF Accelerating Research Translation grant, TIP Directorate, \$6,000,000 over 4 years, in development

The project's primary objectives are to:

- Develop institutional capacity and infrastructure for translational research
- Create and train cohorts of graduate students and postdoctoral researchers in translational research;
- Support a network of ART Ambassadors
- Foster collaborations with partner institutions
- Support Seed Translational Research Projects

Principal Investigator: The Visible Embryo Project

- A multi-institutional, multi-grant, long-term effort to establish an online computational metacenter to support the application of networking and information technologies to the study of early development and morphogenesis, 1991-present
- This project has spawned numerous affiliated research projects over the subsequent decades, including the Next Generation Internet project described below
- The Visible Embryo Project was featured in the 9/6/2002 issue of Science Magazine (<http://bit.ly/2EU0Ckl>)
- Since 2008, the patents resulting from this project have generated over \$250,000,000.00 in license royalties, producing over \$50 million in research revenue for the University of California System

Chief Scientist : Human Embryology Digital Library and Collaboratory Support Tools

- Next Generation Internet Phase II Contract, National Library of Medicine, 1999-2003
- A project to develop and demonstrate technologies to enable collaboration between multiple, distributed researchers and to make progress toward advanced clinical and educational goals
- The project enhanced and integrated sophisticated data capture and analysis procedures at the National Museum of Health and Medicine (NMHM) into a high performance testbed network that was planned to eventually include a petabyte-scale archive and analysis capability
- The project used an existing, government-funded gigabit network to connect key sites across the nation
- The testbed employed a data transport rate of 622 MB/sec in the key regional networks.

Reports: <http://bit.ly/2CHCm7w> and <http://bit.ly/2E7Lq1M>

Principal Investigator: Anatomical Mapping and Visualization System

- SBIR Phase I Grant, National Library of Medicine, 1999-2000
- A complete 3-dimensional multidimensional image-map system was developed which indexes every voxel within the Visible Human Male dataset and relates each voxel with associated anatomical information
- This system was then used to provide an Internet-accessible anatomical name-server
- The project also developed a cross-platform client-server remote visualization application which integrated real-time volume-based interactive visualization of the Visible Human dataset with an interactive object-voxel-based anatomy navigator, all accessible through a Tcl applet embedded in a Web page

Co-Principal Investigator: Internet Atlas of Mouse Embryology

- SBIR Phase I and Phase II Grants, National Institute of Child Health and Human Development, 1993-1997
- Atlas of 3-D microscopic volume data on normal mouse embryos at a variety of developmental stages
- A major feature of the project was to allow interactive visualization of the datasets via the World Wide Web, and to allow the user to interactively query the database by rotating and slicing the data to find a region of interest, and then clicking upon an object in the image to issue the query
- The system uses a 3-dimensional extension of Dr. Doyle's MetaMAP semantic object indexing system to allow as many as 16 million discrete semantic objects to be mapped within a single 3-D dataset

Selected Publications

- Doyle, M. and K. Harrod, Netlab: A platform for crowdsourcing virtual microscopy knowledge, *FASEB Journal*, 2018.32.1 (2018)
- Pescitelli, M.J., S. Huntley, S. Landers, E. Theiss, C. Lilagan, and M. Doyle, Automated system for on-demand generation of photorealistic structure-specific interactive anatomical reconstructions, *FASEB Journal*. 2011.25.495.2 (2011)
- Landers, S. and M. Doyle, WubTk -- Tcl/Tk Apps Anywhere, *Proceedings of the 17th Annual Tcl/Tcl Conference* (2010)
- Pescitelli, M.J., C. Lilagan, S. Huntley, S. Landers, E. Theiss, and M. Doyle, The BioNetLab Anatomy Collaboratory, *FASEB Journal*. 2010;24.827.3 (2010)
- Lilagan, C., M. Doyle, S. Huntley and S. Landers, The use of Tcl/Tk in the AnatLab Virtual Anatomy Laboratory, *Proceedings of the 16th Annual Tcl/Tcl Conference* (2009)
- Landers, S. and M. Doyle, Skybot, *Proceedings of the 15th Annual Tcl/Tk Conference* (2008)
- Doyle, M., C. Lilagan, S. Landers, and S. Huntley, dotNyet, *Proceedings of the 15th Annual Tcl/Tk Conference* (2008)
- Doyle, M., M. Pescitelli, C. Lilagan, S. Landers, S. Huntley, E. Pescitelli and C. Doyle, AnatLab: A Web-based Virtual Anatomy Laboratory, *Proceedings of the 15th Annual Tcl/Tk Conference* (2008)
- Doyle, MD, et al., MultiVIS: A Web-based Interactive Remote Visualization Environment and Navigable Volume Imagemap System, in *28th AIPR Workshop: 3D Visualization for Data Exploration and Decision Making* (2000)
- Doyle, MD, et al., The Visible Embryo Project: A Platform for Spatial Genomics, in *28th AIPR Workshop: 3D Visualization for Data Exploration and Decision Making* (2000)

- Doyle, MD, and H. Schroeder: Interactive Web Applications with Tcl/Tk. Pub: Academic Professional, Boston, ISBN: 0122215400, (1998)
- Doyle M.D., C.S. Ang, D.C. Martin, A. Noe: The Visible Embryo Project: Embedded Program Objects for Knowledge Access, Creation and Management through the World Wide Web. Computerized Medical Imaging and Graphics 20:423-431 (1996)
- Williams, B.S., M.D. Doyle: An Internet Atlas of Mouse Development. Computerized Medical Imaging and Graphics 20:433-447 (1996)
- Williams, B.S. M.J. Pescitelli, M.D. Doyle: The Muritech Internet Atlas of Mouse Embryology. Developmental Imaging Workshop. National Institute of Child Health and Human Development. Bethesda MD September (1997)
- Doyle, M.D, C.S. Ang and D.C. Martin: Proposing a Standard Web API, Dr. Dobb's Journal, February, (1996)
- Doyle, M.D., C.S. Ang, and D.C. Martin: Embedding interactive external program objects within open-distributed-hypermedia documents, High Speed Networking and Multimedia '94, SPIE Press, (1995)
- Ang, C.S., D.C. Martin and M.D. Doyle: Integrated Control of Distributed Volume Visualization Through the World Wide Web. Proc. Visualization '94, IEEE Press, (1994)
- Doyle, M.D, C. Ang, R. Raju, G. Klein, B.S. Williams, T. DeFanti, A. Goshtasby, R. Grzeszczuk, and A. Noe: Processing cross-sectional image data for reconstruction of human developmental anatomy from museum specimens. SIGBIO Newsletter (The Journal of the ACM SIG for Biological Computing),13/1(1993)
- Carlbom, I., W.M. Hsu, G. Klinker, R. Szelski, K. Waters, M.D. Doyle, J. Gettys, K.M. Harris, T.M. Levergood, R. Palmer, L. Palmer, M. Picart, D. Terzopoulos, D. Tonnessen, M. Vannier, and G. Wallace: Modeling and Analysis of Empirical Data in Collaborative Environments, Communications of the ACM, 33/6, 75-84, (1992)
- Doyle, M.D.: The MetaMAP Process: A New Approach to the Creation of Object-oriented Image Databases for Medical Education, Proc. 13th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, IEEE Press (1991)
- Doyle, M.D.: The Use of Fractal Analysis in the Screening of Medical/Dental X-ray and Tomographic Images for Early Signs of Osteoporosis, Proceedings of the 13th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, IEEE Press (1991)
- Doyle, M.D.: A New Method for Identifying Features of an Image on a Digital Video Display, Biostereometrics Technology and Applications, SPIE Press (1991)
- Doyle, M.D.: The Interactive Digital Video Interface Process, "Spatial Displays and Spatial Instruments", NASA Conference Publication #10032 , (1989)
- Doyle, M.D., P.J. O'Morchoe, V. Navas, and C.C.C. O'Morchoe: A Combined Enzyme Histochemical and Computer Image Analysis Technique for the Identification of Intraorgan Lymphatic Vessels in: Progress in Lymphology-XI, H. Partsch, editor, Elsevier Science Publishers (1988)

Selected Invited Colloquia

- "Creating an Advanced Energy Ecosystem in New Mexico," panel at the New Mexico LFC Advanced Energy Conference, Albuquerque, NM, September 14, 2023
- "A Case Study in Translational Research," New Mexico Tech Inventors & Entrepreneurs Workshop, Socorro, NM, April 14, 2023
- "The Visible Embryo Project: The Ontogeny of Technology," Distinguished Keynote Address at the National Academy of Inventors NJIT Workshop on Sustainable Societies: Data Revolution – Innovations to Global Solutions and Next-Generation Cyber-infrastructure, New Jersey Institute of Technology, October 27, 2022
- "Tetralogy of Fallot: Embryology, Anatomy, and Clinical Presentation," Medical Education Seminar, Texas Tech University Health Sciences Center, El Paso, November 14, 2021

- "Connections on the way from chick embryos to a blockchain revolution," 2018 Frank Armitage Lecture Series, University of Illinois at Chicago, Chicago, October 19, 2018
- "The Visible Embryo Next Generation Internet Project," IEEE Engineering in Medicine and Biology Society WC2000 - World Congress on Medical Physics and Biomedical Engineering - Chicago, (July 23-28, 2000)
- "Telepathology and Medical Imaging for the Masses," Supercomputing 99, Portland, OR, 1999
- "Approaching Nonlinearity: Scripting and the Future of the Web Applications Platform," Bioengineering Seminar, Department of Bioengineering, Univ of Toledo, Spring, 1999
- "The Visible Embryo: Virtual Reality through the World Wide Web," IEEE Engineering in Medicine and Biology Society 1996 Annual International Conference - Amsterdam, October, 1996 * "Interactive Content on the Web: The Next Wave of Computing," keynote address at the first Internet@Chicago conference, sponsored by the Chicago Software Association, May, 1996
- "The Embryology Metacenter: Biological applications of supercomputing in a distributed hypermedia environment." Dept of Anatomy and Cell Biol., School of Med., Univ of Michigan, Ann Arbor, March, 1994
- "The Visible Embryo Project: A National Resource for Biomedical Information Technology," presented at the Annual Meeting of the Am. Assn for the Advancement of Science, San Francisco, CA, February, 1994
- "Televisualization for the Support of Research and Education in Developmental Anatomy," a course in the Telemedicine Seminar and Workshop, sponsored by the Armed Forces Institute of Pathology, American Registry of Pathology, and the International Academy of Telemedicine, May, 1993
- "The Embryology Metacenter: A distributed computational resource 'center' for developmental anatomy, 2nd Ann. Conference on Human Developmental Anatomy, Nat. Museum of Health and Medicine, Washington, D.C., December, 1992

Philanthropic Activities (donations of time and money by Dr. Doyle to non-profit organizations)

- Founder & President, 2009-present, Buonacorsi Foundation, Wheaton, IL, <http://buonacorsi.org>
- Founder & Chairman, 2010-present, National Museum of Health + Medicine Chicago
- Donation to National Museum of Health + Medicine Chicago, \$300,000.00, 2016
- Research Grant to UIC College of Medicine, \$500,000.00, 2009-2013, <http://bit.ly/2E8wWil>
- Donation by Dr. Doyle from Eolas to UCSF Chancellor's Fund, \$7,000,000.00, 2008
- Donation to Benet Academy, Lisle, IL, to fund art studio/classroom, \$150,000.00, 2007
- Donation of corporate stock to St. Ignatius College Prep, \$183,000.00, 1998

News Media Coverage

- "UIC Honors Glen Ellyn Resident With Distinguished Alumni Award," Glen Ellyn Patch, June 5 2013 — <http://bit.ly/2BnFlvY>
- "New coding school opens in Chicago," Fox 32 News, June 3, 2015 — <http://bit.ly/2BSSGkC>
- "Einstein's Brain Goes Digital With iPad App," Wired, Sept. 25, 2012 — <http://bit.ly/2BEqkYN>
- "TECH PIONEER'S DREAM MUSEUM," Crain's Chicago Business, June 13, 2011 — <http://bit.ly/2oVBoy9>
- "Happiness is a Jumbo Verdict," American Lawyer, January, 2004 — <http://bit.ly/2z5A8bt>
- "Conqueror at the Gates," Computers in Business, Sunday Business Post, Ireland, September, 2003 — <http://bit.ly/2BPzbtm>
- "The 521-Million-Dollar-Man," USA Today, August, 2003 — <http://bit.ly/2BG3znx>
- "Jury Rules Against Microsoft in Patent Case," New York Times, August 12, 2003 — [http:// bit.ly/2BO3voh](http://bit.ly/2BO3voh)

Selected Patents (of over 30 granted)

Co-creator of the first cloud application platform, spatial transcriptomics, and mobile AI assistants. Creator of transient-key cryptography, the signature-chaining technology that enabled the creation of Bitcoin. Areas of research focus include online education technologies, genomics, biomedical image informatics, data security & cryptographic technologies, mobile computing, digital value technologies, and development of digital STEAM resources for kids.

System and method for architectural integrity assurance in neural networks

- Patent Pending, filed Sept 24, 2023
Inventors: Michael D. Doyle, Paul F. Doyle, and Yuxin Ruan
- In the burgeoning world of neural network-driven applications, ensuring the security and authenticity of AI models has risen as a paramount concern. The advent of the Kairos Tinsor patent pending technology heralds a transformative era in this domain, addressing the profound need to safeguard the architectural integrity of neural networks. By assuring that a model's internal structure remains uncompromised, Tinsor not only elevates the trustworthiness of AI solutions but also bolsters the confidence of industries and end-users alike in adopting these advanced technologies. Tinsor's significance is further accentuated in an environment rife with threats ranging from adversarial attacks to model poisoning. Its capability to provide a verifiable assurance against tampering is a game-changer, especially when the stakes involve critical applications in healthcare, finance, and autonomous systems. Tinsor allows the immense potential of neural networks to be harnessed without compromising on security. Its introduction marks a pivotal step forward, ensuring that the next wave of AI innovations remains robust, reliable, and resilient against malicious threats.

Method and system for multidimensional morphological reconstruction of genome expression activity (AKA: Spatial Transcriptomics)

- U.S. Patent 7,613,571, issued Nov 3, 2009
Inventors: Michael D. Doyle, Betsey S. Williams, Maurice Pescitelli, George Michaels
- The SAGA system (Spatial Analysis of Genomic Activity) enables the automated large-scale discovery of the precise three-dimensional morphological distribution of the simultaneous gene expression activity of tens of thousands of genes in any biological tissue. The system combines the advantages of gene expression detection technology with advanced 3-D visualization methods and advanced data analysis to provide a "snapshot" of the expression activity of all known genes within the spatial context of the biological structure. This system, designed in 2000, pioneered the field now known as Spatial Biology.

Method and apparatus for automatically identifying and annotating auditory signals from one or more parties

- U.S. Patent 10,582,350, Issued March 3, 2020
Inventors: Michael D. Doyle and David C. Martin
- This technology addresses the need to automatically identify and annotate mobile-phone auditory data streams with semantic and structural information. For example, in a telephone conversation between two parties using cellular smart phones, the phone application processes, either locally or remotely or any combination, the auditory data stream to identify the mention of specific entities, e.g. telephone numbers, email addresses, dates and times, locations, etc. These identified entities are displayed to the parties who may indicate actions to

perform with or on that entity, including disregarding due to non-relevance, inaccuracy, imprecision, or other attribute that may be used to train the underlying system on contexts in which those entities are relevant and related additional actions, e.g. adding to contacts, calendar, or other applications on the mobile device.

Automated communications response system

- U.S. Patent 10,011,864, Issued July 3, 2018
Inventors: Steven Landers and Michael D. Doyle
- The Skybot system demonstrated the first mobile intelligent assistant technology, developed over fifteen years ago. The prototype system employed automatic recognition of communication situations by detection of unique telecommunication event characteristics and the consequential responses to those situations by invocation of related programmatic responses. The system allows an end user to specify various patterns of telecommunication event characteristics that describe various situational aspects of incoming communications, such as the timing and originator of voice calls, the content of, timing of, and author of chat messages, etc., as well as appropriate sets of programmatic response actions to be performed in response to those communications, such as initiating conference calls, sending chat messages, routing calls to other users, etc, and even using AI to simulate a conversation with a real person. The system monitors incoming communications, matches characteristic patterns to recognize the situations, and then invokes the matching response actions, thereby automating many functions of the communication system that previously would have had to have been performed manually.

Distributed hypermedia method for automatically invoking external application providing interaction and display of embedded objects within a hypermedia document

- U.S. Patent 9,195,507, Issued November 24, 2015
Inventors: Michael D. Doyle, David C. Martin and Cheong Ang
- This technology is widely used to deliver interactive content over the Web. When it was first demonstrated in 1993, it transformed the Web into an application platform of unlimited potential. A user's personal computer is able to tap into powerful remote computers without having to download large amounts of data to their local machine. The applications in part run remotely and the user interacts with the application data as if on their personal computer. Today, this powerful tool is popularly referred to as "The Cloud," and is used to deliver interactive content over the Web for billions of users every day.

Method and system for transient key digital timestamps

- U.S. Patent 6,381,696, Issued April 30, 2002
Inventor: Michael D. Doyle
- Transient-key cryptography is the immediate technological ancestor of the Bitcoin blockchain system. The invention of this technology was inspired by the belief that real security can only be achieved by ensuring truth, and that truth must be independent of needing to trust individuals. If one can irrefutably and objectively prove that a piece of data existed at a point in time, and hasn't been changed since then, the truth represented by that data can be protected indefinitely. Now a part of the X.9.95 ANSI National Standard for secure financial timestamps, this invention uses concepts such as transient secret cryptographic keys, distributed forward-signature

blockchains, and distributed cross-certification chains to provide a system for irrefutably certifying the time and state of any digital data, without the need for a third-party certificate authority or trustworthy operators.

- From Wikipedia: "Transient-key cryptography is a form of public-key cryptography wherein key-pairs are generated and assigned to brief intervals of time instead of to individuals or organizations, and the blocks of cryptographic data are chained through time. In a transient-key system, private keys are used briefly and then destroyed, which is why it is sometimes nicknamed "disposable crypto." Data encrypted with a private key associated with a specific time interval can be irrefutably linked to that interval, making transient-key cryptography particularly useful for digital trusted time-stamping. ... Transient-key cryptography is the predecessor to [Forward secrecy](#) and formed the foundation of the forward-signature-chaining technology in the [Bitcoin blockchain](#) system." https://en.wikipedia.org/wiki/Transient-key_cryptography

Method and apparatus for identifying features of an image on a video display

- U.S. Patent 4,847,604, Issued July 11, 1989
Inventor: Michael D. Doyle
- The MetaMAP system pioneered the use of clickable image maps in distributed hypermedia systems. It is also believed that the MetaMAP application was the first example of an "open-linking" hypermedia browser, since it employed link references external to any single database. Previously, hypermedia systems were self-contained, representing all links between objects within a single monolithic database. A single small MetaMAP navigator application, on the other hand, could navigate through a potentially unending series of linked documents, no matter how large the collection of navigable documents might be. Later systems, such as the World Wide Web, similarly employed an open-linking architecture. The efficiencies that allowed the first MetaMAP application to provide instant object identification for tens of thousands of clickable objects in high resolution biomedical images, displayed on a 4.77MHz IBM PC, now enable the latest MetaMAP systems to deliver immensely-large multidimensional navigable image spaces for a variety of vertical applications.

Michael D. Doyle, PhD: Commitment to Diversity

Throughout my career, I have maintained an active commitment to diversity, and have strived to recognize the barriers faced in the worlds of science and technology by underrepresented groups such as women, racial & ethnic minorities, those with disabilities, and the LGBTQ+ community.

Being the stepfather of a child on the autism spectrum, I have worked for several years on new technologies to help people on the spectrum be able to communicate their feelings to others. Having a family member on the spectrum, I am intimately aware of the complex day-to-day difficulties that such individuals face. Several years ago, a mobile app side-project I was working on was discovered to have unanticipated potential to provide a tool that can be helpful in overcoming some of the emotional communication barriers that autistic individuals face. At that time, my collaborators on that project and I decided to redirect the app (<http://smurks.net/asd.html>, <https://bit.ly/2XU7cBo>) away from its original entertainment purpose to be fully focused on serving the autism community. We are currently in the process of developing a new version of that app for that specific purpose.

I have been a supporter for many years of several projects and organizations devoted to expanding the opportunities for inner-city youth with respect to preparation for, and admission to, higher education, and advanced training in STEM fields. In the summer of 2010, I sponsored a charity basketball game, pitting me and my siblings against President Obama and his basketball buddies (with Dwayne Wade as a last-minute stand-in for the President), to support Urban Students Empowered (now called OneGoal), one of these organizations (<https://bit.ly/35BfjVW>). A few years later, I donated a domain name that I owned (chitech.org) to another such organization, a local Chicago-area STEM magnet school, and I pre-paid the domain registration costs for 100 years (<https://chitech.org/partners/>). In 2015, I founded CodeAbode, a mobile-application coding bootcamp with a specific aim of training members of under-represented groups, such as women and racial & ethnic minorities, to increase opportunities for them in the high-technology industry (<http://bit.ly/2BSSGkC>).

I have spent considerable time working with the severely disabled, especially in one of my former roles, as the Acting President of the National Museum of Health + Medicine Chicago. Several years ago, I began working with a national organization of spinal cord injury victims, Backbones (<http://backbonesonline.com>), to create projects to facilitate self-expression and community education with respect to the personal stories of Backbones members. That work resulted in two online exhibits: Reinventing the Wheel (<http://vmuseum.com/rtw>), and Redesigning the Game (<http://vmuseum.com/rtg>), that have received worldwide attention. In July 2013, the City Council of the City of Chicago issued a proclamation recognizing both the Backbones founder, Reveca Torres, and me for the work done on the Reinventing the Wheel project (<https://bit.ly/33AslBI>). I continue to maintain both of those online projects to support Backbones and their public outreach efforts.

As a step-parent of a trans teenager, and as a close friend of several members of the LGBTQ+ community, I have an abiding commitment to supporting members of the LGBTQ+ community, both in the workplace and in my private life.

Finally, it is important to embrace diversity not only in the creation of teams, workplace environments and content within organizations, but also to address it in the design, scope and implementation of research projects, knowledge models, tools and repositories. Bias can be baked into information systems at the most fundamental levels, unintentionally introduced via means such as, for example, machine learning training sets of inadequate heterogeneity. It is only through careful attention to inclusive design that research results and information systems can be achieved that are truly representative of the community at large.