CURRICULUM VITAE

Name: Michael Berman
Born: October 21, 1946
Citizenship: Israeli
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Military Service: Officer in the IDF – Armored forces – Rank Major

1. Academic Education

1980	Ph.D.	Tel Aviv University, Israel.
1974	M.Sc.	Tel Aviv University, Israel.
1971	B.Sc.	Tel Aviv University, Israel.

2. Academic Employment

1. Academic Positions

Since 2011	Professor, Head of Computers in Medicine Track Computer Science Department and Chair of the Authority for Research & Development Hadassah Academic College Jerusalem
1984-1990	Director of Computer Unit The Fritz Haber Center, Hebrew University of Jerusalem, Israel
1981-1984	Postdoctoral Fellowship with Prof. L.S Cederbaum, Theoretische Chemie, University of Heidelberg, Germany
1974-1980	Teaching Assistant and Instructor Chemistry Dept., Tel Aviv University, Israel

2. Other Positions

Since 2008	Founder and CTO SONARIUM MEDICAL Ltd., Jerusaelm, Israel
1998-2008	Founder Chairman and CEO BIOMEDICOM Creative Biomedical Computing Ltd., Jerusalem, Israel
1995-1998	General Manager Silicon Graphics Biomedical Ltd. [SGBL], Jerusalem, Israel
1990-1994	European Director of Pharmaceutical and Biomedical Markets Silicon Graphics Inc. Basel, Switzerland

3. Academic Activities:

Previous Research and Development Activities

1. Segmentation of Ultrasound Images:

Medical image segmentation algorithms, applicable to various scenarios were researched. For example, segmentation in ultrasound images of fetal body from surrounding fluid, segmentation of the fetal body from placenta or uterus [usually a very difficult task], segmentation of fetal spine and segmentation of an incomplete

fetal head. An important component of the research was focused on an advanced edge-detection research, a specific approach that handles well a speckled environment of ultrasound images. Model based segmentation has also been studied for specific needs.

2. Fetal Weight Determination with Ultrasound:

The clinical importance of knowing the fetal weight during pregnancy is due to its relation to the development of the fetus. The weight according to the gestational age and the rate of fetal weight increase can indicate normal development or detect growth abnormality. Weight estimation at term is a very important parameter in the determination of cesarean section delivery. This study was focused on developing apparatus and methods for measuring the weight of a fetus in utero using 3-dimensional ultrasound. The work included the research on automating fetal weight calculation based on image processing technologies.

3. 3-dimensional and 4-dimensional ultrasonic imaging:

The study and creation of ultrasonic imaging systems by a variety of technologies, including motorized transducers and free-hand 2-dimensional transducers with inertial [gyroscopic] sensors.

3. The Heart in Ultrasound Imaging:

Three-dimensional fetal echocardiography may improve prenatal screening for fetal heart syndromes. We researched and reported together with clinical collaborators that three dimensional ultrasound diagnoses of fetal cardiac malformations are feasible, and may allow generalists to improve the sensitivity and specificity of their screening evaluation. We have also researched the implementation of intra-heart ultrasound imaging of adults, using accurate electormagnetic positional sensors for obtaining three-dimensional ultrasound of the interior of the heart.

4. Guidance of Minimally Invasive Surgical Procedures using Real-Time 3D Ultrasound:

The objective of this project was to develop a 3D ultrasound technology that will assist the physicians in performing minimally invasive procedures safer, faster and more cost effectively than they are today. This requires advances in both the ultrasound probe and three dimentional (3D) display technologies. These technologies were explored in two forms. One is a 3D laparoscopic probe that is motorized, allowing the physician to acquire 3D without requiring him to scan the transducer manually as well as enabling continuous 3D acquisition and display. A prototype probe was developed and successfully used in animal trials with a target imaging system. The second research aspect was on a real-time (4D) probe for needle guidance.

5. Thermo Field Dynamics:

The application of the Non-Equilibrium Thermo Field Dynamics to molecular systems has been studied. A new Wigner phase space distribution function has been introduced for thermal quasi particles currently in use in Thermo Field Dynamics, thereby permitting a new way for the numerical investigation of quantum and thermal fluctuations.

6. Fast Reactions in Liquids:

Stochastic dynamics has been used in the interaction picture to define energy transfer in collisions within a liquid. Langevin equations of motion with minimum number of physical parameters have been constructed and numerically integrated. The important influence of the liquid's "velocity friction" on the energy transfer efficiency has been studied numerically.

7. Time-dependent Solution of the Liouville von Neumann Equation: Non-dissipative and Dissipative Evolution:

A new method for solving the Liouville von Neumann equation has been developed. Fast Fourier Transform (FFT) is used extensively, this transformation preserving all exact commutation relations. The accuracy and convergence properties of the method have been investigated and compared to an exact solvable model problem. Typical non-trivial applications were studied numerically and included thermal relaxation under constraints of selection rules.

8. Self Consistent Quantal Equations of Motion within the Lie Algebraic Setting: Atom-diatom Collisions:

In this study, a direct and practical new procedure for the computation of density maximal entropy has been implemented. The method determines directly the time evolution of parameters of the density operator using their equations of motion generated via a Lie algebra. Energy transfer to the vibrational motion of the molecule has been determined numerically.

9. Electron Molecule Scattering:

In this research, the electronic and nuclear motions in the target molecule have been investigated in new ways. The electronic problem has been treated within a many-body theory by perturbation methods and a generalized optical potential. The scattering problem has been treated using the Schwinger variational principle. The behavior of important shape resonances has been investigated in detail using a new and sophisticated library of computational tools.

10. Theory of the Double Resonance Raman Amplifier:

The use of stimulated resonance Raman emission in the three-level double resonance has been considered. In this project, a new model has been presented for the steady state three-level resonance Raman amplification, based on an algebraic expression for single molecule amplification, combined with a numerical solution of non-linear equations governing macroscopic collinear propagation.

11. Excited States of Rare-Gas Molecules:

Rare-Gas molecules are chemically unbounded in their electronic ground state. However, many of the electronic excited states are strongly bounded. Their possible usage in UV lasers is of great importance. A new and fast method for obtaining excited-state potentials of rare-gas diatomic molecules has been developed.

12. Statistical Mechanics of Adsorption of Large Molecules on Charged Electrodes:

The influence of the voltage on the sticking of molecules to an electrical double-layer has been studied. This behavior is of interest in electrochemistry. A new statistical

mechanical model has been developed to analyze numerically the experimental findings.

Present Research and Development Activities

1. Fractional Derivative in Classical Physics

   New questions in fundamental physics and in other fields, which cannot be formulated adequately using traditional integral and differential calculus emerged recently. Fractional calculus was shown to describe phenomena where conventional approaches have been unsatisfactory. The driven damped fractional oscillator entails a rich set of important features, including loss of energy to the environment and resonances. In this paper, this oscillator with Caputo fractional derivatives is solved analytically in closed form. The exact solution is expressed in terms of generalized Mittag-Leffler functions. The standard drivendamped Harmonic Oscillator is recovered as a special case of non-fractional derivatives. In contradistinction to the standard oscillator, the solution of the fractional oscillator is shown to decay algebraically and to possess a finite number of zeros. Several decay patterns are uncovered and are a direct consequence of the asymptotic properties of the generalized Mittag-Leffler functions. Other interesting properties of the fractional oscillator like the momentum–position phase-plane diagrams and the time dependence of the energy terms are discussed as well.

2. Fractional Derivative in Quantum Physics

   The number of bound states in a standard rectangular potential well depends on the potential depth and width. In an impenetrable one-dimensional rectangular potential well, there are infinite bound states. In this work we study a non-Hermitian Riesz-Feller kinetic energy; i.e., the second-order derivative of the standard kinetic energy operator is replaced by a fractional, αth-order derivative. We show that for $\alpha < 2$ a particle in an impenetrable one-dimensional rectangular potential well contains a finite number of bound states and an infinite number of metastable decaying states. The transitions from bound states to metastable decaying states occur at α values that correspond to exceptional points, for which two bound states coalesce. Our findings indicate that one can describe a transition of highly excited bound states to metastable decaying states, for example due to the interactions of atoms and molecules with the environment, by using the Riesz-Feller kinetic energy operator rather than the standard one.

3. Ultrasound of the Breast

   Breast cancer is one of the leading causes of death from cancer. Early detection is widely believed to reduce breast cancer mortality by allowing intervention at an earlier stage of cancer progression. Screening [X-ray] mammography has secured a place as the gold standard routine health maintenance procedure for women –a mature technology that provides high-quality images in the majority of patients. However, conventional mammography does not detect all breast cancers, including some that are palpable, and as many as three-quarters of all breast lesions biopsied because of a suspicious finding on a mammogram turn out to be benign. The purpose of this research is to find alternative solutions for early detection of breast cancer.

4. Ultrasound Beamforming and Ultrasound Tomography

   The conventional ultrasound approach is driven by the need for real-time data acquisition and display. Therefore, some of the complex physics associated with propagation of sound waves is traded off. One of the tradeoffs corresponds to the usage of straight-ray theory, a basic approximation of the true physics of acoustic wave propagation, which is only valid for purely homogenous media. A second important tradeoff is the assumption of a two dimensional geometry in which only the directly backscattered reflections are collected. The purpose of this research is to implement beamforming and tomography approaches that "undo" the trade-offs of conventional ultrasound, leading to a marked increase in the signal-to-noise ratio, while reducing artifacts and yielding higher quality images for greater clinical "sensitivity". Furthermore, the signals that propagate through the anatomy, and which are never reflected back, contain additional information.

Other Relevant Activities

1. I have a record of accomplishment for establishing and securing funding for the establishment of four new technology entities. This includes one center in Switzerland and Israel respectively, both part of Silicon Graphics Inc (SGI), and two startup companies in Israel. Under my leadership, these entities have produced state of the art innovative technologies and products.
2. The strategy at SGI is comprised of two key entities: a) The establishment of a market focused European R&D technology center in Basel Switzerland, aimed at developing generic features and tools for this sector. b) The establishment of a network of European-wide sales team, focused on this industry. These two keys combined have created a powerful impact on the success of SGI in this marketplace.
3. The technology center in Basel was placed at the heart of the pharmaceutical industry in Europe. It has become a focal point for defining new ways of using computers in molecular graphics and computational medicine. Furthermore, it provided invaluable input into other Silicon Graphics engineering groups for defining new hardware features according to requirements in the pharmaceutical and medical sectors.
4. While at SGI, I promoted educational programs, related to pharmaceutical and medical technologies. As part of this activity, I have initiated and provided the funds for 20 workstation classrooms at leading universities, including The Hebrew University of Jerusalem.
5. Close connections with major companies and universities throughout Europe have created a competitive position for SGI. Companies like Glaxo, Unilever, BASF, Ciba, Akzo, Roch, SKB, Wellcome, Rhone Pulenc, and Bayer; were at the leading position in this industry. Furthermore, major universities like Cambridge, Hebrew, Weizmann, Uppsala, EMBL, and CNRS have established projects and computer teaching classrooms in molecular biology and chemistry based on SGI technology.
6. My experience as CEO exposed me to the broader business picture of the market, providing me with the proper attitude of putting the customer's needs as our first priority and considering the company's overall goals when defining the target technologies and products. My experience has put me in contact with many high level academic, governmental, industry, defense industry and professional

luminaries from various nations and backgrounds in general and particularly in Israel.

7. As CEO, I established strategic alliances with leading companis such as the Japanese company Aloka (http://www.aloka.com/) and the American Company W.L. Gore & Associates (http://www.gore.com/en_xx/). These relationships included joint technology research and development projects, as well as business partnership.
8. I am the founder and current head of a new study track at the Hadassah Academic College Jerusalem: "Computers in Medicine". The program is a M.Sc. track specializing in hardware and software computer technologies in medicine. The students of this track gain knowledge and practical tools focusing on the needs in the medical device industries and hospitals and in [medical] informatics for the healthcare sector.

4. Grants and Awards

During my activities at the above-mentioned technology and research centers, I have secured granted research and development funding of over 11 million USD. In addition, I have been one of the main contributors/PIs in the following major grants:

Program for International Development in Higher Education Institutions in the "Growth Model" 2020-2022
CHE
Grant: 800,000 NIS

Program for International Development in Higher Education Institutions in the "Growth Model" 2019-2020
CHE
Grant: 1,200,000 NIS

ITEM - Innovative Teaching Education in Mathematics
European Commission (Erasmus+, Brussels, Europe)
2018-10 to 2021-10
Grant: 70,000 Euro
Part of GRANT_NUMBER: 598587

Internationalisation strategy
Council for Higher Education (Jerusalem, Israel)
2018-10 to 2020-10
Grant: 1,500,000 ILS

ASSET - ASSEssment Tools for new learning environments in higher education institutions
European Commission (Erasmus+, Brussels, Europe)
2017-10 to 10-2012
Grant: 100,000 Euro
Part of GRANT_NUMBER: 585587

OCULUS - Optometry Curricum Update for Life long learning through erasmUS
European Commission (Erasmus+, Brussels, Europe)
2016-10 to 2010-10

Grant: 100,000 Euro
Part of GRANT_NUMBER: 574067

CLEVER - Creative Leadership & Entrepreneurship Visionary Educational Roadmap
European Commission (Erasmus+, Brussels, Europe)
2014-10 to 2019-10
Grant: 230,000 Euro
Part of GRANT_NUMBER: 561636

Lifelong Learning in Applied Fileds (LLAF)
European Commission (Tempus, Brussels, Europe)
2013-11 to 2016-02
Grant: 200,000 Euro
GRANT_NUMBER: 543894
I have was the coordinator of this 1 million Euros project, a consortium of 16 higher education institutes, 9 in Europe and 7 in Israel.

5. List of Publications

5.1 Peer Reviewed Papers

1. M. Berman and U. Kaldor, "Fast Calculation of Excited State Potentials for Rare Gas Diatomic Molecules: Ne2 and Ar2", Chem. Phys. 43, 375-383 (1979)

2. Y Rabin, M Berman and A Ben-Reuven, "Theory of the double resonance Raman amplifier", J. Phys. B: At. Mol. Phys. 13 2127-2136, (1980)

3. M. Berman and U. Kaldor, "Electron-Molecule Scattering with Polarization Using the Schwinger Variational Principle", Chem. Phys. Letters 79, 489-493 (1981)

4. M. Berman, U. Kaldor, J. Shmulovich and S. Yatsiv, "Rydberg States and the Observed Spectrum of ArH", Chem. Phys. 63, 165-173 (1981)

5. M Berman and U Kaldor, "The Schwinger variational method in electron-atom and electron-molecule scattering theory with polarization", J. Phys. B: At. Mol. Phys. 14 3993-4005, (1981)

6. M Berman, O. Walter, and L. S. Cederbaum, "Electron-Molecule Scattering in the Optical-Potential Approach: Surpassing Second Order", Phys. Rev. Lett. 50, 1979–1982 (1983)

7. Michael Berman, Hernán Estrada, L. S. Cederbaum, and W. Domcke, "Nuclear dynamics in resonant electron-molecule scattering beyond the local approximation: The 2.3-eV shape resonance in N2", Phys. Rev. A 28, 1363–1381 (1983)

8. H. Estrada, M. Berman, L. S. Cederbaum and W. Domcke, “Theoretical study of electron transmission through N2”, Chem. Phys. Lett. 97, 352 (1983)

9. M Berman, L S Cederbaum and W Domcke, "Analysis of the ambiguities in the definition of the local complex potential in resonant electron-molecule scattering”, J. Phys. B: At. Mol. Phys. 16 875-890, (1983)

10. Michael Berman and Wolfgang Domcke, "Projection-operator calculations for shape resonances: A new method based on the many-body optical-potential approach", Phys. Rev. A 29, 2485–2496 (1984)

11. M Berman and W Domcke, "Direct calculation of complex resonance poles in electron-molecule scattering using separable T-matrix expansions", J. Phys. B: At. Mol. Phys. 17 L453-L458, (1984)

12. W. Domcke, M. Berman, H. Estrada, C. Muendel, L. S. Cederbaum, “Aspects of nuclear dynamics in short-lived negative ion states”, J. Phys. Chem., 1984, 88 (21), pp 4862–4867

13. Michael Berman, Claus Mündel, and Wolfgang Domcke, "Projection-operator calculations for molecular shape resonances: The 2 Sigma +u resonance in electron-hydrogen scattering", Phys. Rev. A 31, 641–651 (1985)

14. Robert B. Gerber, Ronnie Kosloff and Michael Berman, "Time-Dependent Wavepacket Calculations of Molecular Scattering from Surfaces", Comp. Phys. Rep., 5,59-114 (1986)

15. W. Domcke, M. Berman, C. Mündel, and H.-D. Meyer, “Direct calculation of complex resonance poles using separable expansions of the potential: Application to the 2Σu+ shape resonance in electron-H2 scattering”, Phys. Rev. A 33, 222–232 (1986)

16. Michael Berman, "Thermal quasiparticles with phase-space distribution ", Phys. Rev. A 40, 2057–2063 (1989)

17. D. Charutz, M. Berman and R.D. Levine, "An Exponential Gap Relation for Vibrational Energy Transfer in a Dissipative Medium", Chem. Phys. Lett. 164, 495 (1989)

18. Michael Berman, "Wigner phase-space representation of thermal excitations”, Phys. Rev. A 42, 1863–1868 (1990)

19. Michael Berman and Ronnie Kosloff, "Time Dependent Solution of the Liouville Von Neumann Equation: Non-Dissipative Evolution", Comp. Phys. Comm., 63, 1-20 (1991)

20. Michael Berman, Ronnie Kosloff and Hillel Tal-Ezer, "Solution of the time dependent Liouville von Neumann Equation Dissipative evolution", J. Phys. A, 25,1283-1307 (1992)

21. Michael Berman and Lorenz S. Cederbaum, “Fractional driven-damped oscillator and its general closed form exact solution”, Physica A 505, 744–762 (2018)

22. Michael Berman and Nimrod Moiseyev, “Exceptional points in the Riesz-Feller Hamiltonian with an impenetrable rectangular potential”, Physical Review A 98, 042110 (2018)

5.2 Books

5.3 Papers and Abstracts - Proceedings of Conferences

1. M. Zipparo, C. Oakley, R. Denny, S. Azim, V. Balannik, Z. Soferman, M. Berman, R. Nechushtai and D. Kopelman, "3-D Laparoscopic Imaging", 2008 IEEE International Ultrasonics Symposium Proceedings, 40-44.

5.4 Patents

1. Berman Michael, Gessert James, Moore Wayne, Nechushtai Rachel, Rom Hillel, and Soferman Ziv, "3-dimensional ultrasonic imaging", US Patent 6,315,724, November 13, 2001

2. Ziv Soferman and Michael Berman, "Automatic fetal weight determination", US Patent 6,375,616, April 23, 2002

3. Ziv Soferman and Michael Berman, "Facial imaging in utero", US Patent 6,434,260, August 13, 2002
4. Ziv Soferman and Michael Berman, "Determination of fetal weight in utero", US Patent 6,575,907, June 10, 2003

5. Michael Berman, "System and Method for Ultrasound Examination of the Breast", WIPO Patent WO/2012/077111A1, June 14, 2012

6. Michael Berman, "System and Method for Ultrasound Examination of the Breast", Patent Certificate of Chinese Invention, Patent No. 201180066669.5, May 5, 2015

5.5 Technical Reports

1. Michael Berman, Vadim Balannik and Bill Blenn, "Guidance of Minimally Invasive Surgical Procedures using Real-Time 3D Ultrasound", Technical Report,BIRD Project Ref. No.: 1109 (January 2008)

2. Michael Berman, Vadim Balannik and Bill Blen, "Guidance of Minimally Invasive Surgical Procedures using Real-Time 3D Ultrasound", Technical report, BIRD Project Ref. No.: 1109, (December 2008)

3. Michael Berman and Lori Stayton, "Guidance of Minimally Invasive Surgical Procedures using Real-Time 3D Ultrasound", Technical report, BIRD Project Ref. No.: 1109, (April 2009)

4. Michael Berman and Said Azim, "Guidance of Minimally Invasive Surgical Procedures using Real-Time 3D Ultrasound", Technical report, BIRD Project Ref. No.: 1109, (December 2009)

5. Ilan Sinai, Meir Friedman, Ziv Soferman and Michael Berman, "Ultrasound Tomography", White Paper, (April 2010)

6. Michael Berman and Ilan Sinai, "Tomographic Ultrasound of the Breast", Technical report, OCS Project No.: 40930, (May 2010)

7. Michael Berman, "Tomographic Ultrasound of the Breast", Technical report, OCS Project No.: 40930, (October 2011)

8. Michael Berman "Early detection of breast cancer using ultrasound tomography", Healthymagination Challenge, a General Electric Web Publication, http://challenge.healthymagination.com/health/Early-detection-of-breast-cancer-using-u, (November 2, 2011)

9. Michael Berman, Astridd Duernberger, Lea Even, Irit Levy-Feldman, Lydia Linortner, Sara Meilijson, Jean-Luc Patry and Michael Weingarten, “Learning to Be”, An Educational Unit in Lifelong Learning in Applied Fileds (LLAF Tempus IV) pp 1-92, (2017)

10. Moshe Caine and Michael Berman, “CLEVER Handbook”, 2019, https://photo.hac.ac.il/clever/#p=1