Dr. Mark A. Hausman

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Degrees:

Ph.D.	(Astrophysical Sciences)	Princeton University, 1979
M.S.	(Astrophysical Sciences)	Princeton University, 1977
B.S.	(with honors, Astronomy and Astrophysics)	Michigan State University, 1975

Dr. Hausman's specialty is computer programs that model complex physical systems. He specializes in simulations and studies of ionospheric and space physics, and their effects on radar and communications systems. Fields of expertise include data translation (e.g., raw radar data from ROTHR and BMEWS) and data visualization. Dr. Hausman has created GUI's (graphical user interfaces) and users' guides to simplify user interaction with sophisticated applications. He is experienced in using Matlab and the FORTRAN, C, C++, Java, and Visual Basic programming languages.

In September of 2005, Dr. Mark Hausman joined NorthWest Research Associates as a Research Scientist after twenty-one years at Mission Research Corporation. Currently, Dr. Hausman is working on a several projects to increase the accuracy and utility of OTH (over-the-horizon) radar for target tracking and radio direction-finding. These include the application and refinement to new and planned radar systems of CREDO techniques for ionospheric modeling, and the use of ray-tracing and ray-homing in altitude-estimation studies. He has also contributed to HiCIRF, a software HF channel simulator that simulates OTH radar propagation at the antenna element level.

Dr. Hausman has been working in support of the GPSII program, a method to derive accurate models of the earth's ionosphere using timing measurements collected from GPS satellites. The program was originally created to study the correlation of earthquakes with ionospheric precursors, but has much wider utility that is currently being developed. In support of an ongoing HF direction-finding program, he developed the program "IonoSynth", which uses high-fidelity ray-tracing to synthesize the radar and radio-frequency channels implied by GPSII models. In the course of this effort, he also wrote a definitive Interface Control Document that specified user interaction with GPSII and IonoSynth.

Dr. Hausman has also contributed to the SIFTER effort, a signal-processing algorithm that enhances detection of weak targets by OTH and surface-wave radars. He has been involved in developing techniques to mitigate various ionospheric effects, such as Traveling Ionospheric Disturbances (TIDs), ionospheric Doppler shifts, and impulsive noise. The MINER algorithm (Meteor and Impulsive Noise Excision by Regression) has already been delivered as a stand-alone program. Additionally, Dr. Hausman has created the "RunSifter" GUI and "watch_sifter" Matlab scripts to improve SIFTER's ease-of-use.

From 1995, Dr. Hausman has worked on the CREDO and APMA programs, which aim to improve the accuracy of the Navy's Relocatable Over-The Horizon Radar (ROTHR). He wrote a computer program that extracts raw data from ROTHR tape files and translates it into forms accessible to UNIX and Windows computers. He helped develop computer tools that use available ionogram sounding data to specify current ionospheric conditions, which are then used to create Coordinate Registration (CR) tables that translate a target's delay into ground range. A notable achievement was the "Ionoview" program, a Graphical User Interface (GUI) running on ordinary Windows PC's that helps visualize ionogram data and provides a control center to other CREDO analysis programs.

In 1994 and 1995, Dr. Hausman helped to refine and evaluate the PROPMOD computer code, which predicts the effects of ionospheric structure on satellite communications and trans-ionospheric radar propagation. From time to time since, he has updated PROPMOD with newer versions of its component models, including the addition in February 2002 of version 14.03 of WBMOD. A number of special-purpose modifications allow the creation of contour maps showing disturbance over broad geographic regions, the prediction of TEC (total electron content) statistics, and databases showing the probability of achieving specified performance criteria. In 2003, he updated the distributed form of PROPMOD to a subroutine that users may optionally link into their own applications. In 2001 and 2003 PROPMOD was used in support of the MUOS effort, supplying global databases of predicted ionospheric scintillation.

From 1998 to 2002, Dr Hausman worked on the RNECS project, with particular attention to improving the ionospheric corrections used in the BMEWS radar processing algorithms. One aspect of this work was a series of routines translating BMEWS data from raw 60-bit CDC LRIDs into files readable by modern desktop programs (such as Matlab).

In 1999, Dr. Hausman wrote a series of Test Suites and Users' Guides for some of the DTRA codes being delivered to the LIDS program. He has also developed a simple computer model of the x-ray ionization patch created by a high-altitude nuclear burst, suitable for inclusion in an engagement-level simulation code. While developing and testing this model, he has become familiar with the use of NORSE and ASSIST for generating disturbed ionospheres. In 2000, Dr. Hausman did extensive comparisons of his fast XRAYPATCH code to the DTRA standard programs WEDCOM and NORSE, which revealed not only the desirability of further work with XRAYPATCH, but also several differences between the predictions of WEDCOM and NORSE. Dr. Hausman has also served as a beta-tester for ASSIST.

From January 1984, until 1994, Dr. Hausman's work at Mission Research Corporation was concerned with the physics of nuclear bursts at high altitudes. In 1994, he worked with Dr. Bernard Roth to help develop the DGBETS computer code, a fast-running routine encapsulating the Defense Threat Reduction Agency's model for debris deposition from high altitude bursts. DGBETS is intended for incorporation into the engagement-level simulations used by DTRA customers, and has been incorporated into the ASSIST suite.

From 1987 until 1993, Dr. Hausman's principle concern was the CMHD computer code; this code calculates in detail the energy partition and deposition that occurs in the first few seconds following a high altitude nuclear explosion. Dr. Hausman helped to update the CMHD code, adding three-dimensional capability and extending the modeled region to lower altitudes. The CMHD code has been used to model bursts at a number of altitudes from 150 km up; the simulation results have been used to model kinetic energy deposition and radioactive debris distribution in the Northern Conjugate Region.

In connection with the CMHD program, Dr. Hausman developed an interactive computer program that synthesized two-dimensional isophote maps of any desired three-dimensional distribution of volume emission. The program was used to make synthetic images of the deposition patches predicted by CMHD models of the STARFISH event; these were compared to actual STARFISH data as a check on the accuracy of the models.

From 1984 to 1987, Dr. Hausman used another computer simulation program to examine the Naval Research Laboratory's laser/plasma experiments, which were designed to simulate high altitude bursts. Specific concerns were the collisional coupling of expanding debris with the surrounding air and the use of distortions in applied magnetic fields to trace the locations of debris. He also investigated the possible onset of plasma instabilities and fast magnetic pulses in the low-beta regime of the NRL experiments.

Dr. Hausman has also served as a research associate in theoretical astrophysics at the Universities of Texas and Virginia. At Texas his research concentrated upon the interstellar medium and the dynamics and structure of galaxies. His statistical model for the mass spectrum and velocity distribution function of interstellar clouds revealed shortcomings in the standard, collisional theory of cloud growth. He also studied the effects of both gravitational and collisional encounters upon the evolution of giant molecular clouds in the galaxy and demonstrated a dissipationless model for the growth of very large-scale, "frothy" structure in the universe. At the University of Virginia, he used computer models to study the response of a cloudy interstellar medium to the gravitational potentials of spiral galaxies. There he also helped develop a computer model designed to simulate the marginally collisional flow of gas in the rarefied interior of a gas centrifuge.

While a National Science Foundation Graduate Fellow at Princeton University, he developed a three-dimensional hydrodynamics code, which he used to simulate the collisions of self-gravitating interstellar gas clouds. At Princeton, he also engaged in research on the structure of globular star clusters, the effects of terrestrial atmospheric fluctuations on solar observations, and the structural evolution of "cannibal" galaxies, which grow by engulfing their neighbors.

Dr. Hausman's major publications and reports include the following:

"Application Program Interface for the NWRA Ionospheric Modeling System", with S. V. Fridman and L. J. Nickisch, NorthWest Research Associates, NWRA-14-RM556, October 2014.

"A wideband channel probe for space situational awareness," 2013 Beacon Satellite Symposium, Bath, UK, July 8-10, 2013 (with D. L. Knepp and C. M. Spooner).

"HiCIRF: A High-Fidelity HF Channel Simulation," Radio Science, V.47, RS0L11, doi:10.1029/2011RS004928, 2012 (with L J. Nickisch, Gavin St. John S. V. Fridman, and C. J. Coleman).

"Inversion of Backscatter Ionograms and TEC Data for Over-the-Horizon Radar," Radio Sci., 47, doi:10.1029/2011RS004932, 2012 (with L J. Nickisch and S. V. Fridman).

"Real time reconstruction of the three-dimensional ionosphere using data from diverse sources with IRI as a background model," with S. V. Fridman and L. J. Nickisch, Real-Time International Reference Ionosphere Workshop, Colorado Springs, USA, May 4-6, 2009

"GPSII User's Guide", February 2009 (unpublished electronic document).

"PC-based system for real time reconstruction of the three-dimensional ionosphere using data from diverse sources," with S. V. Fridman and L. J. Nickisch, Radio Science, submitted October 2008.

"PC-based system for real time reconstruction of the three-dimensional ionosphere using data from diverse sources," with S. V. Fridman and L. J. Nickisch, XXIX General Assembly of the International Union of Radio Science, Chicago, Illinois, USA, August 7-16, 2008, Paper G04.a4

"PC-based system for real time reconstruction of the three-dimensional ionosphere using data from diverse sources," with S. V. Fridman and L. J. Nickisch, 12th International Ionospheric Effects Symposium Proceedings, Alexandria, VA, 2008, P. 415-426

"SIFTER for ROTHR Users Guide", with S. V. Fridman and L. J. Nickisch, NorthWest Research Associates, NWRA-BELL-07-R350, Revised March 2008.

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"SIFTER for CODAR," with S. V. Fridman and L. J. Nickisch, Final Technical Report, NWRA-Bell-06-R322, May 2006.

"TID Mitigation for OTH Radar and High-Fidelity HF Propagation Modeling," with L. J. Nickisch and S. V. Fridman, Final Technical Report, NWRA-BELL-06-R318, March 2006.

"Real-time reconstruction of the three-dimensional ionosphere using data from a network of GPS receivers," with S. V. Fridman, L. J. Nickisch, and Mark Aiello, Radio Sci., 41, RS5S12, doi:10.1029/2005RS003341, 2006.

"Range rate–Doppler correlation for HF propagation in traveling ionospheric disturbance environments," with L. J. Nickisch, and S. V. Fridman, Radio Sci., 41, RS5S39, doi:10.1029/2005RS003358, 2006.

"OTH Radar Propagation Analysis," with Sergey V. Fridman, Kevin Collins, Mark Aiello, and L. J. Nickisch, Mission Research Corporation report MRC/MRY-R-119, July 2005.

"Earthquake Remote Precursor Sensing by Inversion of GPS Two-Frequency Beacon Data," with Sergey V. Fridman, L. J. Nickisch, and Mark Aiello, Mission Research Corporation report MRC/MRY-R-118, May 2005

"Traveling Ionospheric Disturbance Effects and Modeling for Over-the-Horizon Radar," with L. J. Nickisch and Sergey V. Fridman, Mission Research Corporation report MRC/MRY-R-117, April 2004.

"The MINER Algorithm for Impulsive Noise Excision from ROTHR Data", with L. J. Nickisch and S. V. Fridman, Mission Research Corporation, MRC/MRY-R-115, September 2003.

"The PROPMOD Subroutine: A Flexible Tool for Computing Propagation and TEC Parameters," with L. J. Nickisch and D. L. Knepp, Mission Research Corporation, MRC/MRY-R-113, June 2003.

"SIFTER Users Guide", with S. V. Fridman and L. J. Nickisch, Mission Research Corporation, MRC/MRY-R-112, July 2003.

"SIFTER: Signal Inversion For Target Extraction and Registration—Coherent Processing of IQ Data", with L. J. Nickisch and S. V. Fridman, Mission Research Corporation, MRC/MRY-R-111, July 2003.

"The PROPMOD Subroutine: Propagation Parameters and a TEC Model," with L. J. Nickisch and D. L. Knepp, Mission Research Corporation, MRC/MRY-R-106, May 2002.

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"Comparison of the 'XRAYPATCH' Model to WEDCOM and NORSE,", Mission Research Corporation, MRC/MRY-R-087, June 2000.

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"PROPMOD User's Guide and Test Suite: Computing Transionospheric Radio Propagation Parameters," with L. J. Nickisch and D. Knepp, Mission Research Corporation, MRC/MRY-R-082, October 1999 (revised October 2001).

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