Kai Virtanen
CURRICULUM VITAE

Personal information:

Name:	Virtanen, Kai Matti Olavi
Birth date:	February 23, 1970
Birth place:	Hyvinkää, Finland
Citizenship:	Finnish

Addresses:

Office:	Aalto University
	School of Science
	Department of Mathematics and Systems Analysis
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Education:

- *Doctor of Technology*, Helsinki University of Technology, Department of Engineering Physics and Mathematics, August 23, 2005, Accepted with distinction
  Major: Systems and Operations Research
  Minor: Mathematics
  Thesis title: Optimal Pilot Decisions and Flight Trajectories in Air Combat
- *Master of Science*, Helsinki University of Technology, Department of Information Science, January 30, 1996, Accepted with distinction
  Major: Systems and Operations Research
  Minor: Energy Economics
  Thesis title: Visual Interactive Aircraft Trajectory Optimization

Academic career:

- July 2017 – Present: *Professor of Practice* in the joint professorship of Operations Research at Department of Mathematics and Systems Analysis, School of Science, Aalto University and at Department of Military Technology, National Defence University, Finland
- November 2013 – June 2017: *Professor of Practice*, Aalto University, School of Science, Department of Mathematics and Systems Analysis, Espoo, Finland
- August 2011 – Present: *Adjunct Professor*, National Defence University, Department of Warfare, Helsinki, Finland
- January 2010 – Present: *Docent*, Aalto University, School of Science, Department of Mathematics and Systems Analysis, Espoo, Finland
- January 2012 – October 2013: *University Lecturer*, Aalto University, School of Science, Department of Mathematics and Systems Analysis, Espoo, Finland
- January 2010 – December 2011: *Teaching Research Scientist*, Aalto University, School of Science, Department of Mathematics and Systems Analysis, Espoo, Finland
- January 2007 – December 2009: *Teaching Research Scientist*, Helsinki University of Technology, Systems Analysis Laboratory, Espoo, Finland
- April 1996 – December 2006: *Research Scientist*, Helsinki University of Technology, Systems Analysis Laboratory, Espoo, Finland
- September 2001 – February 2002: *Visiting Researcher*, University of South Australia, School of Mathematics, Adelaide, Australia
- June 1995 – March 1996: *Research Assistant*, Helsinki University of Technology, Systems Analysis Laboratory, Espoo, Finland
- September 1994 – May 1995: *Teaching Assistant*, Helsinki University of Technology, Systems Analysis Laboratory, Espoo, Finland

- June 1994 – August 1994: *Research Assistant*, Helsinki University of Technology, Systems Analysis Laboratory, Espoo, Finland

- *Project Manager* in the following research projects, Aalto University or Helsinki University of Technology, Department of Mathematics and Systems Analysis:
    - 2021 – 2024: Finnish Air Force, *Improving Tactical Use of Aircraft Fleet 4*
    - 2023 – 2024: Finnish Defence Forces*, Defence Forces Research Programme: Situational Awareness and Sensor Fusion*
    - 2021 – 2023: Finnish Defence Forces*, Defence Forces Research Programme: Decision Support for Joint Operations*
    - 2021 – 2022: Ministry of Defence*, Effects of Wind Power Farms on Military Readiness*
    - 2017 – 2020: Finnish Air Force, *Improving Tactical Use of Aircraft Fleet 3*
    - 2013 – 2016: Finnish Air Force, *Improving Tactical Use of Aircraft Fleet 2*
    - 2014 – 2015: Finnish Air Force, *Modeling of Anti-Aircraft Defense Capability against Projectiles*
    - 2014 – 2015: Finnish Air Force, *Simulation-Optimization of Maintenance Systems*
    - 2010 – 2012: Finnish Air Force, *Improving Tactical Use of Aircraft Fleet*
    - 2010: Finnish Air Force, *Optimization of Flight Routes and Base Locations*
    - 2010: Finnish Defence Forces, *Center of Gravity Analysis using Bayesian Networks*
    - 2007 – 2009: Finnish Air Force, *Modeling of Air Operations*
    - 2000 – 2007: Finnish Air Force, *Dynamics and Strategy of Flight*
    - 2000 – 2007: Finnish Air Force, *Analysis of Maintenance Systems under Uncertain Operating Conditions*
    - 1999 – 2001: Patria Finavitec Ltd, *Target Selection Algorithms*

Research interests:
- Simulation including simulation-optimization and simulation metamodeling
- Dynamic optimization and games
- Human behavior and performance in complex systems
- Military operations research including combat modeling and simulation
- Multicriteria and spatial decision analysis including Bayesian networks and influence diagrams

Language skills:
Finnish (Native), English (Good), Swedish (Moderate)

Military service:
1990-1991: Finnish Defence Forces; Rank: Senior Lieutenant

Professional activities:
- Reviewer for
    - Annals of Operations Research
    - Environmental Modeling and Assessment
    - Ergonomics
    - European Journal of Operational Research
    - Group Decision and Negotiation
    - IEEE Transactions on Aerospace and Electronic Systems
    - IEEE Transactions on Automatic Control
    - IEEE Transactions on Knowledge and Data Engineering
    - IEEE Transactions on Systems, Man, and Cybernetics
    - Journal of Guidance, Control, and Dynamics
    - Journal of Military Studies
    - Journal of Operational Research Society
    - Journal of Optimization Theory and Applications
    - Mathematical Problems in Engineering
    - Operations Research
    - OR Spectrum
    - Simulation Modelling Practice and Theory
    - Socio-Economic Planning Sciences
- Reviewer of research projects for *Israel Science Foundation* (ISF)
- Member of international programme committee: ASTEC, *Asian Simulation Technology Conference*, 2010 – 2015

- Chairman of *the Systems Analysis Section of the Scientific Advisory Board for Defence* (MATINE), 2016 – Present, Member 2013 – 2015
- Member of
  - *Finnish Operations Research Society* (FORS)
  - *International Society of Dynamic Games* (ISDG)
  - *International Society on Multiple Criteria Decision Making*
- Representative of Aalto University and Helsinki University of Technology at *the Consortium of Finnish Virtual University Network for Teaching Mathematical Modeling*, 2002 – 2015
- Supervisor: *Finnish Doctoral Education Network in Systems Analysis, Decision Making and Risk Management*, 2005 – Present
- Deputy member of *Master's Programmes Committee of Engineering Physics, Mathematics and Operations Research*, School of Science, Aalto University, 2015 – Present
- Member of *Research Council*, National Defence University of Finland, 2017 – Present

Decorations, awards and grants:
- Best Paper Award Year 2017 of Journal of Aviation Psychology and Applied Human Factors, 2017
- The Operations Researcher of the Year 2015 nominated by the Board of Finnish Operations Research Society
- Medal for Military Merits, 2013
- Systems Analysis Laboratory Research Group, Department of Mathematics and Systems Analysis, School of Science, Aalto University; Teacher of the Year 2011
- Systems Analysis Laboratory, Helsinki University of Technology; Teacher of the Year 2007 and 2008
- Helsinki University of Technology; Award for PhD, 2005
- Emil Aaltonen Foundation, 2000
- Finnish Foundation for Technology Promotion, 1999
- Wihuri Foundation, 1997

Teaching experience:
- Courses lectured (Aalto University or Helsinki University of Technology)
  - "*Systems Analysis Laboratory I*: Selected topics on System Dynamics, Systems Thinking, and Time Series Analysis," 2003-2021
  - "*Systems Analysis Laboratory II*: Selected topics on Control Theory and Dynamic Optimization," 2003-2021
  - "*Studio Course on Methods of Physics and Mathematics,*" 2015-2021
  - "*System Identification,*" 2007-2016, 2018, 2020
  - "*Simulation,*" 2016
  - "*Introduction to Statistical Analysis,*" 2006-2014
  - "*Dynamic Optimization,*" 2000-2003
- Classes and exercise sessions organized in Senior staff officer course (National Defence University)
  - "*Introduction to Operations Research and Operational Analysis,*" 2018, 2020
  - "*Supporting Decision Making with Modeling and Simulation in Finnish Air Force,*" 2018, 2020
  - "*Introduction to Multi-Criteria Decision Analysis,*" 2020
  - "*Thesis Seminar,*" 2019, 2020, 2021
  - "*Research Methods in Military Studies: Modeling and Simulation,*" 2017, 2019
  - "*Research Methods in Military Studies: Value Tree Analysis and Analytic Hierarchy Process,*" 2017, 2019
  - "*Implementation and Facilitation of a War Game for Testing and Evaluation of Air Capabilities,*" 2019
- Classes and exercise sessions organized in Advanced course on military technology and economy (National Defence University)
  - "*Operational Analysis in Finnish Defence Forces,*" 2018-2020
  - "*Introduction to Multi-Criteria Decision Analysis including Value Tree Analysis,*" 2018-2020
  - "*Utilization of Value Tree Analysis in Development of Military Concepts and Capabilities,*" 2018-2020
  - "*Introduction to Optimization including Linear, Integer and Mixed-Integer Programming,*" 2020, 2021
  - "*Use of Modeling and Simulation in Selection of Weapons Systems,*" 2019

- Classes and exercise sessions organized in Staff officer course (National Defence University)
  - o "*Multi-Criteria Evaluation of Courses of Action,*" 2018-2021
- Classes and exercise sessions organized in Master's course in military sciences (National Defence University)
  - o "*Research Methods in Military Studies: Introduction to Military Operations Research and Operational Analysis; Multi-Criteria Decision Analysis; Optimization," 2021*
  - o "*Introduction to Value Tree Analysis,*" 2020
  - o "*Utilization of Value Tree Analysis in Planning of Military Concepts,*" 2020
  - o "*Linear, Integer and Mixed-Integer Programming,*" 2019
  - o "*Value Tree Analysis and Analytic Hierarchy Process,*" 2019
- Seminars organized (Helsinki University of Technology)
  - o "*Seminar on Optimization: Bayesian Networks and Influence Diagrams,*" 2005
  - o "*Seminar on Optimization: Influence Diagrams and Belief Networks,*" 1999
- Supervision of web-based courses (Aalto University or Helsinki University of Technology)
  - o "*Mathematical Modelling,*" 2000-2021
  - o "*Web-based Courses in Systems Analysis,*" 2005-2006, 2014-2020
  - o "*Multicriteria Optimization,*" 2000-2001
- Teaching assistant (Helsinki University of Technology)
  - o "*System Identification,*" 2005
  - o "*Systems Research Seminar,*" 2000-2001
  - o "*Dynamic Optimization,*" 1997-1999
  - o "*Seminar on Optimization: Fuzzy Mathematical Models,*" 1997
  - o "*Graduate Seminar on Applied Mathematics: Stochastic Dynamic Optimization,*" 1996
  - o "*Mathematical Modelling,*" 1995
  - o "*Applied Probability,*" 1994
- Visiting lectures
  - o "*Multi-Criteria Evaluation of Course of Actions,*" National Defence University, 2010-2017
  - o "*Supporting Decision Making with Modeling and Simulation in Finnish Air Force,*" National Defence University, 2013-2016

Supervision of theses:
- Doctoral theses in Aalto University or Helsinki University of Technology
  - o Sampsa Ruutu, 2019; Tuomas Lahtinen, 2018; Jirka Poropudas, 2011, awarded the "*Doctoral Dissertation of the Year in the Doctoral Programme in Science*" prize of 2011, School of Science, Aalto University; Janne Karelahti, 2008; ongoing: Mikko Harju, Pekka Laitila, Ville Mattila, Juha Mäntysaari, Heikki Puustinen
- Three Doctoral theses ongoing in National Defence University; Pre-examination of one thesis
- Twelve Senior staff officer course theses in National Defence University
- Ten Staff officer course theses in National Defence University
- Master's theses in Aalto University or Helsinki University of Technology
  - o Tuomas Suominen, 2021; Nina Gunell, 2019; Verneri Lauksio, 2019; Visa Linkiö, 2018; Eero Rantala, 2018; Riku Hyytiäinen, 2017; Pekka Laitila, 2013; Heikki Puustinen, 2013; Mikko Harju, 2013; Juho Kokkala, 2010; Jouni Pousi, 2009; Jaakko Sotkasiira, 2006; Jirka Poropudas, 2005; Tiia Järvenpää, 2003; Ville Mattila, 2002; three theses ongoing
- Three Master's theses in National Defence University; four theses ongoing
- Approximately 70 Bachelor theses and Special assignments in Aalto University or Helsinki University of Technology; four theses ongoing

Conference presentations:
- 10th Military Science Days, Helsinki, Finland, November 3-4, 2021, "*Victory of Combat using Modeling – Use of Live-Virtual-Constructive Simulation in Testing and Evaluation of Air Combat Tactics, Techniques and Procedures*"
- 6th Nordic Military Operational Analysis Conference, Kjeller, Norway, October 29, 2019, "*Live-Virtual-Constructive Simulation Framework for Testing and Evaluation of Air Combat Tactics, Techniques and Procedures*"
- 9th Military Science Days, Helsinki, Finland, May 24-25, 2018, "*Victory of Combat using Modeling – Air Force Case: Planning of Air-to-Surface Operations*"
- 21st Conference of International Federation of Operational Research Societies, Québec City, Canada, 17-21 July, 2017, "*Spatial Multi-Attribute Decision Analysis with Incomplete Preference Information*"

- 9th EUROSIM Congress on Modelling and Simulation, Oulu, Finland, September 12-16, 2016, ”*Simulation Metamodeling using Dynamic Bayesian Networks with Multiple Time Scales*”
- 4th Nordic Military Analysis Seminar, Helsinki, Finland, June 1-2, 2015, ”*On Modeling, Simulation and Optimization of Military Air Operations*”
- Winter Simulation Conference 2014, Savannah, GA, USA, December 7-10, 2014, "*Optimizing Locations of Decoys for Protecting Surface-based Radar against Anti-Radiation Missile with Multi-Objective Ranking and Selection*"
- 25th European Conference on Operational Research, Vilnius, Lithuania, July 8-11, 2012, "*Simulation Metamodeling using Bayesian Networks*"
- 21st International Conference on Multiple Criteria Decision Making, Jyväskylä, Finland, June 12-17, 2011 "*Utilization of Multi-Criteria Influence Diagrams in Simulation Metamodeling*"
- 20th International Conference on Multiple Criteria Decision Making, Chengdu, China, June 21-26, 2009, "*Maintenance Scheduling of Fighter Aircraft Fleet with Multi-Objective Simulation-Optimization*"
- 20th International Conference on Multiple Criteria Decision Making, Chengdu, China, June 21-26, 2009, "*Multiple Criteria Optimization and Analysis in the Planning of Effects-Based Operations (EBO)*"
- INFORMS Annual Meeting 2008, Washington, DC, USA, October 12-15, 2008, "*Game Theoretic Approach to Air Combat Simulation*"
- 2nd Nordic Military Analysis Symposium, Stockholm, Sweden, November 17-18, 2008, "*Games and Bayesian Networks in Air Combat Simulation Analysis*"
- Winter Simulation Conference 2007, Washington, DC, USA, December 9-12, 2007, "*Flight Time Allocation for a Fleet of Aircraft through Reinforcement Learning*" (poster presentation)
- 46th IEEE Conference on Decision and Control, New Orleans, Louisiana, USA, December 12-14, 2007, "*Identifying the Guidance Law of an Air-to-Air Missile using Bayesian Reasoning*" (poster presentation)
- INFORMS International, Hong Kong, China, June 25-28, 2006, ”*A Multistage Influence Diagram Game for Maneuvering Decisions in Air Combat*”
- European Simulation and Modelling Conference 2005, Porto, Portugal, October 24-26, 2005, ”*Simulating Pilot's Decision Making by an Influence Diagram Game*”
- 11th International Symposium on Differential Games and Applications, December 18-21, 2004, Tucson, Arizona, USA, ”*Multistage Influence Diagram Game for Maneuvering Decisions in Air Combat*”
- 1st Nordic Military Operational Research Symposium, Helsinki, Finland, October 26-27, 2004, ”*Influence Diagram Game Modeling of Maneuvering Decisions in One-on-One Air Combat*”
- 1st Nordic Military Operational Research Symposium, Helsinki, Finland, October 26-27, 2004, ”*Optimal Pilot Decisions and Flight Trajectories in Air Combat*”
- Finnish Operations Research Society - 30th Anniversary Conference, Helsinki, Finland, November 13, 2003, ”*Optimal Maneuvering and Flight Trajectories in Air Combat*” (in Finnish)
- 1st Bayesian Modeling Applications Workshop of the 19th Conference on Uncertainty in Artificial Intelligence, Acapulco, Mexico, August 7, 2003, ”*Influence Diagram Modeling of Decision Making in a Dynamic Game Setting*”
- 10th International Symposium on Differential Games and Applications, St. Petersburg, Russia, July 8-11, 2002, ”*An Influence Diagram Approach to One-on-One Air Combat*”
- AIAA Guidance, Control, and Navigation Conference, Montreal, Canada, August 6-9, 2001, ”*Modeling Pilot's Sequential Maneuvering Decisions by a Multistage Influence Diagram*”
- 9th International Symposium on Differential Games and Applications, Adelaide, Australia, December 18-21, 2000, ”*Team Optimal Signaling Strategies in Air Combat*”
- 4th Noon2nooN Seminar on Decision Sciences and Applications, Helsinki, Finland, December 16-17, 1998, ”*Modeling Pilot Decision Making by an Influence Diagram*”
- AIAA Modeling and Simulation Technologies Conference, Boston, MA, USA, August 10-12, 1998, ”*Modeling Pilot Decision Making by an Influence Diagram*”
- EUROSIM'98 Simulation Congress, Espoo, Finland, April 14-15, 1998, ”*A Decision Analytic Approach to Flight Simulation*”
- IEEE International Conference on Systems, Man, and Cybernetics, Orlando, Florida, USA, October 12-15, 1997, ”*VIATO - Visual Interactive Aircraft Trajectory Optimization*”
- 10th European Simulation Multiconference, Budapest, Hungary, June 2-6, 1996, ”*Interactive Aircraft Trajectory Optimization and Simulation*”