

## Part I: CURRICULUM VITAE

### 1. Personal

Department of Sensing, Information and Mechanization Engineering,  
 Institute of Agricultural Engineering,  
 ARO, The Volcani Center, Israel  
 e-mail: victor@volcani.agri.gov.il  
 web –site: <http://www.agri.gov.il/en/people/21.aspx>

Dates	Description
1962	Born in Athens, Greece.
1972-1980	High-school education in Lycee Leonin high school, Athens, Greece.
1980	Immigration to Israel

### 2. University Education and Additional Training

Dates	Description
1981-1985	<b>B.Sc.</b> in Agricultural Engineering at the Technion - Israel Institute of Technology. (Cum Laude)
1985-1988	<b>M.Sc.</b> in Agricultural Engineering at the Technion - Israel Institute of Technology Title of thesis: “Design and control of water distribution pattern from linear moving laterals” Supervision by: Prof. Ilan Amir
1988-1992	<b>D.Sc.</b> in Agricultural Engineering at the Technion - Israel Institute of Technology. Title of thesis: "Machine classification of potato shoots for automated mass micropropagation". Supervision by: Prof. Kalman Peleg
1993 - 1995	<b>Postdoctoral position</b> at the Agricultural Engineering Dept., Texas A&M University, with Prof. Stephen W. Searcy Research subject: “Adaptive sorting of fresh produce”. Part of BARD project US-2199-92C

### 3. Positions Held and Academic Status

Dates	Description
1995	Research Scientist, ARO, The Volcani Center, Institute of Agricultural Engineering
2004	Promoted to Senior Scientist (Rank B) (equivalent to Assistant Professor)
2009	Promoted to Senior Scientist (Rank A) (equivalent to Associate Professor)
2016	Promoted to Senior Scientist (Rank A+) (equivalent to Professor)
2007-2013	Head, Department of Sensing, Information and Mechanization Engineering, Institute of Agricultural Engineering, ARO, The Volcani Center, Israel
2013 – 2019	Director of Institute of Agricultural Engineering, ARO, The Volcani Center, Israel

#### 4. Training / Teaching Experience

##### A. Academic Contribution:

<b>Dates</b>	<b>Description</b>
2011 – to-date	<b>Lecturer</b> at the Faculty of Civil Engineering, Dept. of Agricultural Engineering, Technion Title of course: "Introduction to Precision Agriculture".
2012	<b>Lecturer</b> at the Dept. of Geography, Ben Gurion University: "Remote sensing workshop on precision agriculture topics" (graduate course).
2002	<b>Lecturer</b> at the Department of Industrial Engineering at Ben Gurion University "Advanced topics in Artificial Intelligence" (graduate course).
2001	<b>Lecturer</b> at the Department of Industrial Engineering at Ben Gurion University: "Artificial Intelligence" (undergraduate course).
1994	<b>Lecturer</b> at the Dept. of Agricultural Engineering, Technion: "Introduction to control" (course 074061).
1988 – 1992	<b>Instructor</b> at the Dept. of Agricultural Engineering, Technion: "Introduction to control" (074061), "Laboratory in control" (074062), "Systems and control" (076205), "Models and simulation of agricultural systems" (076433).
1985 – 1987	<b>Teaching assistant</b> at the Dept. of Agricultural Engineering, Technion: "Introduction to control" (074061), "Systems and control" (076205), "Laboratory in control" (074062), "Earthmoving equipment and systems" (074040)

##### B. Guidance of M.Sc. Students:

<b>Graduation date</b>	<b>Name</b>	<b>Title of thesis</b>	<b>Guidance with</b>
1999	*Mr. Leonid Ridel	Multispectral Image Processing For Selective Application of Herbicides, Department of Electrical Engineering, Tel Aviv University, the Iby And Aladar Fleischman Faculty Of Engineering	Prof. L. Yaroslavsky
2001	*Mr. Shahar Laykin	Multi-sensor quality control system for agricultural produce, Dept. of Industrial Engineering and Management, Ben-Gurion University of the Negev	Prof. Y. Edan
2004	*Mr. Shahar Barnea	Chicken Filet 3-D Modeling, Dept. of Industrial Engineering and Management, Ben Gurion University of the Negev	Prof. H. Stern
2006	*Mr. Omri Safren	Estimation of apples yield using hyper spectral imaging, Dept. of Industrial Engineering, Ben Gurion University of the Negev	Dr. O. Levi
2007	Mr. Eitan Sela	Estimation and mapping of cotton water status by means of thermal imaging, Faculty of Agriculture, Rehovot	Prof. Y. Saranga and Dr. Y. Cohen

<b>Graduation date</b>	<b>Name</b>	<b>Title of thesis</b>	<b>Guidance with</b>
2009	*Mr. Roy Efron	Development of an integrated approach of weeds detection for site specific weed management, Faculty of Agriculture, Rehovot	Prof. U. Shani
2011	*Ms Adi Prigojin	Estimation of palm trees water stress using thermal infrared remote sensing, Dept. of Geography, Ben Gurion University of the Negev	Prof. D. Blumberg
2013	*Mr. Avi Cohen	Development of thermal and visible imaging based technology for estimating water stress in almond and palm crops, Dept. of Industrial Engineering, Ben Gurion University of the Negev	Dr. O. Levi and Dr. Y. Parmet
2013	*Ms Sharon Nissimov	Classification between obstacle and non-obstacle in a greenhouse environment using Kinect sensor, Dept. of Computer sciences, Bar Ilan University, Tel Aviv	Dr. Y. Goldberg
2015	*Ms Vered Dekel Ben-Yakov	Vegetation stress detection by a thermal hyperspectral sensor, Faculty of Civil Engineering, Technion – Israel Institute of Technology, Haifa	Prof. R. Linker
2015	*Mr. Ofri Golomb	Early detection of Red weevil using thermography. Hebrew University of Jerusalem, Dept. of Geography	Dr. N. Levin
2016	*Mr. Omri Krikov	Estimation of flowering intensity in apple orchards for site specific chemical thinning, Faculty of Agriculture, Rehovot.	-
2016	*Mr. Assaf Alon	Thermal remote sensing for vineyards water management, Faculty of Agriculture, Rehovot.	-
2019 (expected)	Ms Shahar Gad	Early detection of corn and sunflower stress induced by chemical spraying	Prof. Yael Edan
2020 (expected)	Ms Tidhar Sadoski	Early detection of Fuzarium infestation in corn	Prof. Yael Edan

\*under my direct supervision

### C. Guidance of Ph.D. Students:

<b>Graduation date</b>	<b>Name</b>	<b>Title of thesis</b>	<b>Guidance with</b>
2008	*Mr. Shahar Laykin	Feature selection for sorting systems, Dept. of Industrial Engineering and Management, Ben Gurion University of the Negev	Prof. Y. Edan
2009	Mr. Shahar Barnea	Fusion of spectral, photogrammetric and LIDAR sensors for 3D assessment and measurement of short-range scene, Dept. of Geoinformatics Civil Engineering, Technion, Haifa	Dr. S. Filin

Graduation date	Name	Title of thesis	Guidance with
2009	Mr. Ofir Almog	Hyperspectral reflectance components separation using wavelet decomposition coefficients, Dept. of Geoinformatics, Civil Engineering, Technion, Haifa	Prof. M. Shoshani
2011	*Ms. Ronit Rud	Spatial-spectral indicative pixels of salinity effects in leaves: a case study of three crops, Dept. of environmental and agricultural engineering, Faculty of Civil Engineering, Technion, Haifa	Prof. M. Shoshani

\*under my direct supervision

#### D. Post-Docs and Visiting Scientists:

Dates	Name	Research subject
1998 – 1999	Dr. Li GuangYong	Prediction of Nitrogen stress by reflectance techniques
2007 – 2008	Dr. Juan Wachs	Detection of apples for robotic fruit harvesting
2012 – 2013	Li Feng	Prediction of Nitrogen status of potato plants

## 5. Activity in Scientific and Agricultural Committees

#### A. International:

Dates	Description and role
1996 – 2000	BARD proposal evaluation panel; <b>Member</b>
2001, 2005 – 2008	BARD proposal evaluation panel; <b>Chairman</b>
2010 – to date	Section Board VII of CIGR (International Commission of Agricultural Engineering); <b>Member</b>
2012 – to date	<b>Co-Chair</b> of scientific committee and member of organizing committee of the Special conference on machine vision – 2012 in Valencia, Spain (with CIGR and EuroAgEng), 2014 at Zurich, 2016 at Aarhus, Denmark (with CIGR and EuroAgEng)
2012 – to date	CIGR Working group: Image analysis for agricultural processes and products; <b>Vice-chair</b>
2009 – 2014	Management Committee of the ICT-AGRI ERANET; <b>Member</b>
2015	<b>Chair</b> of the 10 <sup>th</sup> European Conference on Precision Agriculture (ECPA)
2015 – 2018	<b>Member</b> of BARD Technical Advisory Board (TAC)
2018 – to date	<b>Secretary</b> of the International Society of Precision Agriculture (ISPA)

#### B. National:

Dates	Description and role
1996 – 2000	Scientific Review Committee (Agricultural Engineering), Chief Scientist of Ministry of Agriculture; <b>Member</b>

<b>Dates</b>	<b>Description and role</b>
2001, 2005 – 2008	Scientific Review Committee (Agricultural Engineering), Chief Scientist of Ministry of Agriculture; <b>Chairman</b> .
2001 – 2003	Research Proposal Steering Committee (Field Crops), Chief Scientist of Ministry of Agriculture; <b>Member</b>
2000 – 2004	The Central Committee for Standards in Mechanics, The Israeli Institute of Standards; <b>Member</b> .
2009	Research Proposal Steering Committee (Precision agriculture), Chief Scientist of Ministry of Agriculture; <b>Member</b>
2009 – 2012	Steering and Scientific Review Committee (ad-hoc committee for labor saving projects), Chief Scientist of Ministry of Agriculture; <b>Chairman</b>
2016- to date	Extension Service (SHAHAM) committee for proposals evaluation; <b>Member</b>

## 6. Contribution to the Scientific Community

### A. International:

<b>Dates</b>	<b>Description</b>
2011	<b>Co-chair</b> of Organizing committee of the Dahlia Greidinger Agri-sensing International conference on sensing in Agriculture, Haifa, Israel;
2013	<b>Member</b> of organizing committee and of the Dahlia Greidinger and BARD International conference on advanced methods for investigating nutrient dynamics in soil and ecosystems, Haifa, Israel;
2012 – to date	<b>Member</b> of Governing board of CIGR Working Group on Image Analysis for Agricultural Products and Processes
2009 – to date	<b>Chair</b> of Working Group on Automation and Emerging Technologies of the European Society of Agricultural Engineering
2009 – to date	Scientific committee of the International Conference on Agricultural Engineering Scientific committee EuroAgEng conference on Agricultural Engineering, September 6-8, 2010 – Clermont-Ferrand, France; <b>Member</b>
2011	Scientific committee the Dahlia Greidinger Agri-sensing International conference on sensing in Agriculture, Haifa, Israel; <b>Member</b>
2013	Scientific committee of the Dahlia Greidinger and BARD International conference on advanced methods for investigating nutrient dynamics in soil and ecosystems, Haifa, Israel; <b>Member</b>
2007 – to date	Scientific committee of ECPA conferences – European conferences on Precision Farming; <b>Member</b>
2015	<b>Chair</b> and organizer of 10 <sup>th</sup> ECPA conference – European conferences on Precision Agriculture, Tel Aviv, Israel.
2015	<b>Co-Organizer</b> of a BARD International Workshop on Robotics in Precision Agriculture; ARO, Israel

### B. National:

<b>Dates</b>	<b>Description</b>
2009- 2106	Chair of Sessions in the Annual Meetings of the Israeli Society of Agricultural Engineering.

C. Editorial responsibilities:

<b>Dates</b>	<b>Description</b>
2011 – 2012	<b>Guest Editor</b> , Biosystems Engineering, special issue on sensors in agriculture.
2012 – 2014	<b>Editorial board</b> of ISRN Machine Vision ( <a href="http://www.hindawi.com/isrn/mv/editors/">http://www.hindawi.com/isrn/mv/editors/</a> )
2014	<b>Reviewer</b> Ph.D. thesis; Food Engineering, University of Budapest, Hungary.
2013 – to date	<b>Editorial board</b> , NIR VATELEM (Agricultural Engineering, in Hebrew)
2013 – to date	<b>Editorial board</b> , Biosystems Engineering
2014 – to date	<b>Editorial board</b> , Precision Agriculture
2016 – to date	<b>Associate editor</b> , Precision Agriculture

7. Active Participation in Meetings

A. International:

<b>Date</b>	<b>Title of the Meeting</b>	<b>Place</b>	<b>Role</b>
1989	The 5th International Irrigation Conference	Tel-Aviv, Israel.	Speaker
1995	ASAE Annual International Meeting	Chicago, IL, USA	Speaker
1997	3 <sup>rd</sup> International Symposium on Sensors in Horticulture	Tiberias, Israel	Speaker
1997	1 <sup>st</sup> European Conference on Precision Agriculture	Warrick, UK	Participant
1998	ASAE Annual International Meeting	FL, USA	Participant
2000	Postharvest 2000	Jerusalem, Israel	Participant
2000	The XIV Memorial CIGR World Congress	Tsukuba, Japan	Session chair, speaker and poster
2002	EuroAgEng International conference on Agricultural Engineering	Budapest, Hungary	Speaker
2003	ASAE Annual International Meeting	NV, USA	Speaker (2)
2004	XXth Congress International Society for Photogrammetry and Remote Sensing	Istanbul, Turkey	Participant
2004	EurAgEng International conference on Agricultural Engineering	Leuven, Belgium	Participant
2005	5 <sup>th</sup> European Conference on Precision Agriculture	Uppsala, Sweden	Poster
2006	Society of Experimental Biology International conference on imaging techniques for plant stress detection	Canterbury, UK	Speaker
2006	The Annual Meeting and an International Conference in Cooperation with the "Agritech 2006" Exhibition, Advances in agricultural technologies and their economic and ecological impacts	Tel Aviv, Israel	Session chair
2006	ASABE International conference on Agricultural Engineering	OR, USA	Poster

<b>Date</b>	<b>Title of the Meeting</b>	<b>Place</b>	<b>Role</b>
2006	EuroAgEng and CIGR conference on Agricultural Engineering	Bonn, Germany	Participant
2006	Innovation Day	Bramstrup, Denmark	Invited speaker, full reimbursement of expenses
2007	Workshop on: A new approach to future farming: small and light-weight agrobots	Wageningen, The Netherlands	Invited speaker
2007	Dahlia Greidinger symposium - Advanced Technologies for Monitoring Nutrient and Water Availability to Plants	Haifa, Israel	Invited speaker
2007	6th ECPA, European Conference on Precision Agriculture	Skiathos, Greece	Speaker and session chair
2008	EuroAgEng conference on Agricultural Engineering	Crete, Greece	
2009	FRUTIC09	Conception, Chile	Speaker
2009	6th EARSeL SIG IS workshop on imaging spectroscopy	Tel Aviv, Israel	Participant
2009	7th ECPA, European Conference on Precision Agriculture	Wageningen, The Netherlands	Speaker (2), poster and session chair
2010	EuroAgEng conference on Agricultural Engineering	Clermont-Ferrand, France	Speaker and session chair
2010	I Simposio Peruano de Percepción Remota y SIG 2010	Lima, Peru	Inviter speaker, full reimbursement of expenses
2011	8th ECPA, European Conference on Precision Agriculture	Prague, Czech Republic	Session chair
2011	Spatial2 – spatial data methods for environmental and ecological processes	Foggia, Italy	Invited speaker, full reimbursement of expenses
2011	The 7th International Workshop on Nondestructive Quality Evaluation of Agricultural, Livestock and Fishery Products	Taipei, Taiwan	Invited speaker, full reimbursement of expenses
2012	EuroAgEng and CIGR conference on Agricultural Engineering	Valencia, Spain	Poster and session chair
2012	11th ICPA, International Conference on Precision Agriculture	IN, USA	Speaker and session chair
2013	9th ECPA, European Conference on Precision Agriculture	LLeida, Spain	Speaker and session chair
2013	Workshop on Precision Agriculture	Bangog, Taiwan	Invited speaker, full reimbursement of expenses
2013	Conference on Satellite applications for multi-level irrigation management: capitalizing on experience to drive regional innovation	Badajoz, Spain	Invited speaker, full

<b>Date</b>	<b>Title of the Meeting</b>	<b>Place</b>	<b>Role</b>
			reimbursement of expenses
2013	ASA, CSSA, and SSSA International Annual Meeting. Water, Food, Energy and Innovation for a Sustainable World	FL, USA	Invited speaker – 2 talks, partial reimbursement of expenses
2015	Workshop on Precision Farming	Milan, Italy	Invited speaker, full reimbursement of expenses
2015	BARD International Workshop on Robotics in Precision Agriculture	Rishon LeZion, Israel	Invited speaker, full reimbursement of expenses
2015	University of Thessaly international seminars	Volos, Greece	Invited speaker
2015	10th ECPA, European Conference on Precision Agriculture	Rishon LeZion, Israel	Chair of organizing committee
2016	Water Management Strategies for Perennial Crops with Limited and Impaired Water Supplies	CA, USA	Invited speaker, full reimbursement of expenses
2016	10th Agriculture, Forestry and Food Industry Creation of Future Forum	Seoul, Korea	Keynote presentation, full reimbursement of expenses
2017	International Conference on Sustainable Agriculture and Bio-economy	Thailand	Plenary speaker, partial reimbursement of expenses
2017	11 <sup>th</sup> ECPA European Conference on Precision Agriculture	Edinburgh, Scotland	Speaker
2018	NSDA project preparation	Bangkok, Thailand	Speaker

B. National:

<b>Date</b>	<b>Title of the Meeting</b>	<b>Role</b>
1991	The 8th Israeli Symposium on Artificial Intelligence and Computer Vision, Tel Aviv	Speaker
1992	The Annual Israeli Symposium on Plant Tissue Cultures and Plant Molecular Biology, Rehovot	Speaker
2000	The Annual meeting of Flowers Board	Opening lecture
2004	Workshop of Engineers Association	Invited lecture
2004	Netafim, Magal	Invited lecture
2006	Israel-Polish conference on Soil and water, Tel Aviv	Invited lecture
2006	Stonefruits annual meeting, Northern R&D	Invited lecture
2006	Milouof, Haifa bay	Invited lecture
2007	the Israel Weed Society, Rehovot	Invited lecture
2010	US-Israel workshop on sustainable buildings, Technion, Haifa	Invited lecture



<b>Date</b>	<b>Title of the Meeting</b>	<b>Role</b>
2012	Agro Mashov, Tel Aviv	Keynote presentation
2014	Haifa Chemicals, Haifa	Invited lecture
2016	Workshop on Precision Agriculture, Rishon LeZion	Keynote presentation

## 8. Research Grants

### A. International Competitive Grants:

<b>Year</b>	<b>Granting Source</b>	<b>Duration (years)</b>	<b>Role*</b>	<b>Title (short)</b>	<b>Budget (US \$ / year)</b>	
					<b>Total</b>	<b>Researcher</b>
1997	BARD	3	<b>PI</b>	Prediction of Nitrogen stress by reflectance techniques	120,000	46,000
1999	EU	1	<b>CI</b>	PRECISPRAY – Precise spraying in orchards	500,000	20,000
2001	BARD	3	<b>LPI</b>	X-ray and Laser Range Imaging for Detection of Bone Fragments and Hazardous Materials in De-boned Poultry Fillets	108,000	49,000
2004	BARD-TIE	3	<b>PI</b>	Improved analysis of thermally sensed crop water status and mapping spatial variability for site specific irrigation scheduling	100,000	35,000
2005	BARD	3	<b>LPI</b>	Enhancement of Sensing Technologies for Selective Tree Fruit Identification and Targeting in Robotic Harvesting Systems	100,000	45,000
2006	BARD-AAFC	1	<b>CI</b>	Optimizing the combination of hyper-spectral images in management zone delineation for variable rate nitrogen fertilization	100,000	10,000
2006	The Dutch-Israel Agricultural Science and Technology Program	1	<b>CI</b>	A new approach to future farming	16,000	2,000
2007	IWMI	2	<b>LPI</b>	Global Soil Salinity Mapping (GSSM) in the Irrigated Areas using Remote Sensing	12,000	6,000

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
2009	EU-ERANET	4.5	LPI	ICT and Robotics in Agriculture and related Environmental Issues	622,322	38,895
2009	BARD	3	CI	Fusion of Hyper-Spectral and Thermal Images for Evaluating Nitrogen and Water Status in Potato Fields	108,000	25,000
2010	BARD	3	CI	Automated Imaging Broiler Chick sexing for Gender-Specific and Efficient Production	108,000	24,000
2011	EU-FOOD-FP7	3	CI	An integrated approach to improve the quality and safety of fresh cuts	1,389,112	26,670
2011	EU-FP7	3	CI	Strategies for the eradication and containment of the invasive pests <i>Rhynchophorus ferrugineus</i>	1,389,112	1,1112
2012	EU-ICTAGRI	3	PI	USER-PA - USability of Environmentally sound and Reliable techniques in Precision Agriculture	488,967	55,564
2014	EU-ERANET2	4	CI	ICT-AGRI-2, Coordination of European Research within ICT and Robotics for sustainable Agriculture	657,883	7,017
2014	EU-ENPI	2	CI	FruitFluNet: A Location-aware System for Fruit Fly Monitoring and Pest Management Control	922,370	66,677
2014	BARD	3	LPI	Innovative yield mapping system using hyperspectral and thermal imaging for precision tree crop management	105,000	50,000
2018	China-Israel Cooperative Scientific Research	2	CI	Green smart city: using precision agriculture technologies in Green high-rise building (hrb) walls	998,200	20,000

\*PI = Principal Investigator; LPI= Local Principal Investigator; CI = Cooperating Investigator

B. National Competitive Grants:

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
1996	Chief Sc.	3	CI	A system for quality sorting of fruits	28,600	
1998	Chief Sc.	3	PI	Machine vision for automatic inspection of geophytes	19,230	19,230
1998	Chief Sc.	3	CI	Quality sorting and counting of ornamental fish by computer vision	25,000	5,000
1999	Chief Sc.	3	PI	Determination of optimal operating parameters for planters by machine vision	20,000	20,000
2001	Chief Sc.	3	CI	Selective harvesting and sorting edible fish by a computer vision system	20,000	5,000
2002	Chief Sc.	3	CI	Quality evaluation of apples using NIR hyperspectral imaging	20,000	5,000
2004	Chief Sc.	3	CI	Development of GIS support for orchard disinfestation	25,000	
2004	Chief Sc.	3	CI	Development of tools to reduce within vineyard variability for the improvement of wine quality	25,000	10,000
2005	Chief Sc.	3	PI	Detection of crop water stress using thermal imaging	25,000	20,000
2005	Chief Sc. (Energy)	3	CI	Development of climate control system for greenhouses	20,000	-
2006	Space Agency	3	CI	Development of the scientific infrastructure for incorporating future multi- and hyper- spectral satellite imagery like Venus in precision agriculture applications	95,000	25,000
2007	Chief Sc. (Science)	3	LPI	Development of an imaging system for early estimation of apple orchard yield	18,000	5,000
2007	Chief Sc.	3	CI	Dates internal quality evaluation using NIR spectroscopy	25,000	5,000

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
2007	Chief Sc.	1	CI	An automatic system for counting ornamental fish	30,000	5,000
2007	Chief Sc.	3	CI	Sorting of flowers using machine vision	30,000	5,000
2008	Chief Sc.	3	LPI	Rachis freshness of table grapes in storage	30,000	3,750
2009	Chief Sc.	3	PI	Development of thermal remote sensing system for water status monitoring in palm trees for irrigation management and malfunction recognition	27,500	12,500
2009	Chief Sc.	5	CI	Development of a robotic system for spraying in pepper greenhouses	130,000	10,000
2009	Chief Sc.	3	CI	Development of a robotic system for spraying in vineyards	40,000	-
2009	Chief Sc.	3	CI	Aerial thermal imaging for automatic detection of irrigation malfunctions	113,473	50,000
2009	Chief Sc.	2	PI	Ground based thermal imaging system to detect irrigation malfunctions	65,000	33,000
2009	Chief Sc.	3	CI	Automated imaging broiler chicksexing for gender-specific and efficient production	80,000	25,000
2010	Chief Sc. (MEIZAM)	3	CI	Integrated Bromrape management approach in agricultural crops	460,000	-
2010	Chief Sc. (MEIZAM)	3	CI	Improving Cotton Profitability Using a Multi-Disciplinary Approach	309,722	25,000
2010	Chief Sc. (MEIZAM)	3	LPI	Improving the ability of Israeli winter rainfed grain crops to face temperature and water instability	110,000	15,000
2010	Chief Sc.	3	CI	Development of a handheld NIR system for evaluation of maturity	18,000	-
2010	Chief Sc.	3	CI	Fusion of non-destructive techniques to detect maturity and quality of bell peppers	25,000	-
2010	Chief Sc.	3	LPI	Development of an automatic system for	30,000	2,000

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
				objective cows body scoring		
2011	Chief Sc. (MEIZAM)	3	CI	Development of area wide strategy for the red palm weevil for agricultural and urban areas	137,000	-
2012	Chief Sc.	1	LPI	Development of decision support system for automatic irrigation control in nectarines and peaches	50,000	17,500
2013	Chief Sc.	3	LPI	Automated Identification of potato's diseases through digital images- implementation and applications	49,044	10,758
2013	Chief Sc.	3	CI	Delineation of management zones for fertilization and irrigation using aerial hyper-spectral and thermal images	40,650	-
2014	Chief Sc. (Extension)	1	CI	Effect of growing media depth and irrigation regime on green roof plants	11,627	-
2014	Chief Sc. (MEIZAM)	3	*PI	Development of a DSS system for apple trees thinning based on precision agriculture principles	112,860	22,572
2015	Chief Sc. (KANDEL)	3	*PI	Precision agriculture - Development of systems to improve resources application in the field	958,329	364,062
2017	Israel Innovation Authority	3	CI	Phenomics	120,000,000	2,5000,000

\*PI = Principal Investigator; LPI= Local Principal Investigator; CI = Cooperating Investigator  
Chief Sc. = Chief scientist of the Ministry of Agriculture, unless otherwise stated.

C. Other Funds:

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
1997	Flowers Board	2	PI	Machine vision for automatic inspection of geophytes	3,500	3,500
1998	Fruits Board	1	CI	Automatic sorting of 'Hiyani' dates	4,300	-

Year	Granting Source	Duration (years)	Role*	Title (short)	Budget (US \$ / year)	
					Total	Researcher
2001	Vegetable Board	1	CI	Characterization of anti-virus nets	4,000	-
2000	Shahar Diagnostics	2	PI	Detection of ear infections by spectroscopic methods	15,000	15,000
2002	Vegetables Board	1	PI	Grading of sunflower seeds using machine vision	5,000	5,000
2004	Diary Board	1	PI	A decision support system for behavior driven cows cooling	8,000	8,000
2004	ARO	1	PI	Thermography-based technology for precision farming management in grapevine: site-specific irrigation for controlling water stress variability	18,750	18,750
2005	Cotton Growers Board	1	CI	Use of near-infrared aerial images for management of cotton irrigation	10,000	2,000
2005	Northen R&D	1	CI	Development of a system for non destructive detection of <i>Alternaria</i> in apples.	10,000	2,000
2005	Committee of Energy	3	CI	Development of a control system for optimal climate control in greenhouses	10,000	-
2006	Horowitz fund	2	PI	Development of a system for site specific spraying of weeds in cotton fields.	15,000	15,000
2006	Horowitz fund	2	CI	Use of near-infrared aerial images and thermal sensing for management of cotton irrigation	15,000	-
2007	Cotton Board	1	CI	Plant cover monitoring using airborne IR images for irrigation monitoring in cotton fields	10,000	2,000
2008	STEPAC	1	PI	Models for prediction of remaining shelf life (RLS) of agricultural products	12,000	12,000
2013	ARO	1	PI	UAV for Precision Agriculture	118,110	118,110

\*PI = Principal Investigator; LPI= Local Principal Investigator; CI = Cooperating Investigator

## 9. Awards

<b>Dates</b>	<b>Description</b>
2006	First price for best paper, ISPRS2006: Remote Sensing: From Pixels to Processes, Enschede, the Netherlands
2009	Inventors Award Approved by the internal committee of the Ministry of Agriculture and Rural Development
2009	First price for best paper, Synergy and Technical Development 2009 Gödöllő, Hungary

## Part II: LIST OF PUBLICATIONS

<b>Marks:</b>	
<b>S</b>	Student, technician or post-doc under my supervision
<b>*</b>	Equal contribution

### 1. Articles in Reviewed Journals

1. **Alchanatis, V.** and Amir, I. (1990)  
A pattern fit coefficient for water application.  
*Irrigation and Drainage Systems* 4:29-36.  
IF 1.948; Agronomy; Rank 18/83, Q1
  
2. Amir, I. and **Alchanatis, V.\*** (1992)  
Procedure for predicting and designing moving sprinkler application patterns.  
*Irrigation Science* 13:93-98.  
IF 1.948; Agronomy; Rank 18/83, Q1
  
3. **Alchanatis, V.**, Peleg, K. and Ziv, M.. (1993)  
Classification of tissue culture segments by color machine vision.  
*Journal of Agricultural Engineering Research* 55:299-311.  
IF: 1.997; Agricultural Engineering, Rank 5/12, Q2
  
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## **Part III: DESCRIPTION OF MAJOR ACHIEVEMENTS**

### **1. Contribution to Agricultural and/or Environmental Sciences**

My general contribution to agricultural science focuses in development and application of advanced optical and digital sensing technologies in several agricultural fields. In the field of Precision Agriculture, I developed systems for weeds detection, leaf nitrogen detection and water stress assessment. The same technologies were the basis for development of systems for sorting, grading and nondestructive quality assessment of agricultural entities, both from the animal (fish and cows) and plant (apples, tomatoes, dates and more) husbandry, as well as for phenotyping.

A number of students do their final projects, Masters and PhD degrees in multi-disciplinary projects under joint supervision with faculty members from the Technion (Civil and Agricultural Engineering), Tel Aviv University (Mechanical Engineering) and Ben Gurion University (Industrial Engineering) and Bar Ilan University (Computer Science).

During the recent years, my main contribution was in three major advanced fields in agricultural engineering: Development of sensing systems (spectral, multispectral, thermal and multi-modal), Precision farming and Computer vision.

#### **a. Development of sensing systems**

I lead and was involved in the development of various sensing systems, among them spectral sensors, spectral imaging systems, multispectral, thermal and multi-modal imaging.

Hyperspectral imaging techniques were investigated and new methods were proposed for processing the data. New techniques for processing spatio-temporal spectral data were proposed (41, 51, 52 and book chapter 2) and adaptive classification methodologies were developed (47).

Thermal imaging was proposed as an alternative imaging technique in the field as well in the lab. Algorithms for combination of visible and thermal imaging for fruit detection were developed in the field of multimodal imaging (40).

Continuing the work on spectral sensing of fresh agricultural produce, a system for estimating internal quality of peppers was developed, a combination of several sensors was evaluated, and a novel method for quality assessment using multi-sensor input was conceived (60, 64, 67) . The developed sensing system is incorporated in a prototype that is further being developed for use in commercial scale.

## **b. Precision Farming**

Thermal imaging, as well as computer vision and spectroscopy are employed as sensing methods for information acquisition in precision farming activities:

I continued the development of an optical sensor for in-field prediction of nitrogen stress. The last five years I extended the use of spectral sensors for potatoes and together with other research groups in Sde Boker, Israel and Canada, and Minnesota, we developed methods for Nitrogen and water stress detection (45, 48, 59, 61, 66).

Furthermore, I continued to lead research on thermal infrared imaging as a sensing method to detect water status for irrigation management. Extensive work during the past five years has placed our group within the leading research groups in this topic in the world. Methods for water status evaluation were extended and refined for olives (39), palms (46), potatoes (59) and cotton (68). Following the results of our research, I lead a wide multi-disciplinary project (project KANDEL) that combines 12 partners from 7 leading organizations in Israel, to bring these findings to application. In addition to the peer reviewed articles, the results of these projects have been presented in several national and international conferences.

In the international scientific community, I am on the editorial board and act as an associate editor of the leading international journal Precision Agriculture. Also, I chaired the 10<sup>th</sup> European Conference on Precision Agriculture, which was held in Israel in 2015.

## **c. Computer Vision – Hardware and Software**

I lead the development of computer vision systems, hardware integration as well as development of image processing algorithms in several fields in agricultural engineering:

Detection of fruits on the trees for robotic harvesting or yield estimation and targeting of robotic arms. Algorithms for detection of oranges and green apples in visible RGB images were developed, and combined with thermal infrared images (26, 31, 32, 40 Book 1, Proc. 57 ), flowering intensity in orchards, grapes appearance (42, 58), ornamental and edible fish (17, 22, 24). In addition, computer vision systems for livestock precision farming were developed (54, 55, 65). Furthermore, algorithms for hyperspectral image processing were developed to detect green apples (23).

In the international scientific arena, I am a member of the editorial board of the leading European journal Biosystems Engineering, and act as the Israeli scientific director of a European effort for research coordination in the field of robotics and ICT in agriculture – ICTAGRI ERANET. Since 2012, I am also the vice-chair of the working group on image processing, of the international society on agricultural engineering (CIGR).

## **2. Achievements in Applied Research**

Computer vision and other sensing techniques are applied fields of research. Some activities have resulted to systems that were used by farmers commercially:

A novel system for determination and mapping of plant water stress through thermal imaging for site-specific irrigation scheduling has been developed. My contribution relies mainly on the development of advanced image processing techniques for water status evaluation, using thermal data, visible images and meteorological data. The developed system was applied as a prototype system during summer 2008 when a commercial service provider (AGAM) together with our groups and the group from MIGAL provided to several farmers from Yizrael valley maps of water status of cotton fields (Abstr 23). This method has been extended for olives (30, Proc 51, Proc 58) where both basic and applied research is performed. Commercial palm tree plantations were also measured and mapping procedures have been developed (Proc. 58). This work is now extended through a three year project that has been approved for funding by the Ministry of Agriculture. Since 2015, I lead a multidisciplinary project that was approved to establish a commercial basis to apply precision agriculture in irrigation.

In cooperation with Dr. Zion, a machine vision system was developed for counting fish fry for ornamental species. I contributed my expertise in pattern recognition and classification, along with the image processing algorithms and on-line implementation. The idea has been filed for a patent, while several such systems are today operable in farmers' farms.

Optical sensing and machine vision for olive maturity estimation was developed and included in a patent application that has been filed. The sensing algorithms are part of the chemo-optic system for improving oil quality by better scheduling of olive picking (Pat. 2)

I have also established acknowledged expertise among the scientific and agricultural communities in the field of machine vision and thermal imaging. Several agricultural organizations like farmer corporations (e.g., YAHAM and Netafim), extension specialists and well established commercial companies (e.g., ELTA, IAI, Stepac, SCD) seek professional consulting and cooperation in the field of application of various sensing techniques and models in agricultural fields.

In addition, I cooperate with several scientists of the ARO and contribute my expertise on advanced systems based on imaging technologies (e.g. entomology, horticulture and crop protection scientists). This last activity has led to publications in scientific literature (20, 21, 42, 44, 49, 58, 62, 69)) and has an impact on the promotion of the scientific level of research in other departments.