# Agricultural Research Organization (ARO) – Volcani Center

The Agricultural Research Organization (ARO) is a governmental research institute dedicated to the highest quality of basic and applied research in agricultural and environmental science. Volcani is the largest institute for Agricultural and Environmental research in Israel. ARO's scientific findings and leadership in agricultural research has driven more than 80% of agricultural advances in Israel and contributed to progress in life sciences globally. Furthermore, Volcani innovations, perhaps most impressively, surpass country borders and diplomatic relations to impact populations and quality of human life all around the world. ARO's six institutes are dedicated to distinct subjects in Plant Sciences, Animal Science, Plant Protection, Soil, Water and Environmental Sciences, Agricultural Engineering, and Postharvest and Food Sciences.

The ARO:

- Strives to foster and advance agriculture, environmental quality, and involvement of the relevant industries in Israel, through the integration of practical and basic research.
- Encourages research and development initiatives based on original thinking and creativity, identifies gaps in knowledge, and opens new avenues in agricultural research.
- Advises the Ministry of Agriculture and Rural Development and the Government of Israel on agricultural and environmental research, development, training, and planning.
- Endeavors to publish its research findings in the scientific and professional literature and to exploit these findings in cooperation with the business sector and with other research organizations.
- Participates in the guidance of trainees and the instruction of students, in coordination with institutions of higher learning in Israel and worldwide, to establish the next generation of agricultural researchers.
- Maintains its position in the forefront of science in the realms of agriculture and environmental quality, in cooperation with research organizations and universities in Israel and abroad, and with international bodies active in the same fields of activity.

**Contents:**

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| **Short Bio:** | Senior research scientist at the Institute of Agricultural Engineering at ARO. His research interests include sensing technologies and their application to agricultural and environmental systems: optical sensing in the visible, near-infrared and thermal infrared spectrum, hyper-spectral and multi-spectral image processing, computer vision and classification systems. These sensing technologies are applied to precision farming in field crops, orchards and protected cultivation, as well as for non-destructive testing of fruits and vegetables in post-harvest systems. Graduated from Technion (Israel institute of Technology) and a post-doc at Texas A&M University in the US. He served as the director of Agricultural Engineering Institute at Volcani Center for six years. He has authored and co-authored more than 70 papers in international peer-reviewed journals and more than 100 in other journals and conference proceedings. He is on the editorial board of leading journals on precision agriculture and agricultural engineering and the secretary of the International Society of Precision Agriculture. |
| **Main Areas of Activity:** | Sensors for precision agriculture: hyperspectral and thermal imaging; Computer vision; Multispectral image processing; Quality Evaluation of agricultural products by non-destructive methods. |
| **Brief description of proposed project:** | |
| **Keywords:** | Precision agriculture; computer vision; pattern recognition; spectroscopy; hyper spectral imaging; thermography; machine learning; |

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| **Short Bio:** | Graduated from The Hebrew University in plant pathology and microbiology. My Ph.D. studies focused on postharvest pathology. My post-doctorate at Weizmann institute focused on fruit-fungal pathogens interaction at the genomic and transcriptomic level. From 2013, I am a group leader at Volcani Research Center. My group focuses on subtropical fruit physiology and pathology, which include fruit microbiome, fruit-fungal interactions, induced resistance to pathogens and chilling. |
| **Main Areas of Activity:** | Mango and avocado stem-end microbiome. Fruit-fungal interaction. Induced defense response in fruits. Anthocyanin and phenylpropanoids role in fruit. Tolerance to biotic and abiotic stress. Cold-quarantine for fruits. |
| **Brief description of proposed project:** | 1. Photonics to determine quiescent infections in harvested fruit. 2. Photonics to determine harvested fruit ripening. 3. Developing sensors to determine fruit chilling. |
| **Keywords:** | Quiescent infection, fruit ripening, chilling injuries, hyperspectral camera, luminescence, fluorescence. |

| Name: | Bechar Avital |
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| **Short Bio:** | Prof. Avital Bechar is a senior research scientist and the director of the Institute o Engineering (IAE). He was appointed adjunct professor at Purdue University, USA, in the years 2011-2012.<br>He holds a B.Sc. degree in Aerospace Engineering and a M.Sc. in Agricultural Engineering, both from the Technion, Israel, and a Ph.D. in Industrial Engineering from Ben-Gurion University, Israel, on agricultural robotics and human–robot integrated systems.<br>Prof. Bechar is the founder and head of the Agricultural Robotics Lab at IAE, where he is conducting fundamental and applied research in robotics for agriculture, human-robot collaborative systems, sensor technologies and developing new concepts and approaches for the operation and development of agricultural robots.<br>He is the author of more than 100 articles in peer reviewed scientific publications. He authored several book chapters and has leaded and participated in more than 40 local and international research projects.<br>Prof. Bechar is the former chairman of the Israeli Society of Agricultural Engineering (ISAE), a co-founder of the Israeli Robotics Association (IROB), a member of the IEEE Technical Committee on Agricultural Robotics, a member of the intelligent automation and robotics work group (AE09) of the European Society of Agricultural Engineers (EurAgEng), a member of the CIGR Section V committee (Systems management) and till recently, an associate editor of the IEEE Transactions on automation, Science and Engineering journal. |
| **Main Areas of Activity:** | Agricultural robotics, human-robot systems, proximal sensing, image processing,  biotic and abiotic stress detection, production engineering of agricultural processes, |
| **Brief description of proposed project:** | |
| **Keywords:** | Agricultural robotics, human-robot system, HRI, proximal sensing, hyperspectral imagery, disease detection, stress detection |

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| **Name:** | **Bonfil David J.** |
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| **Short Bio:** | My achievements relate to dryland agronomy and cropping Systems from several aspects: crop production and quality, crop management, and precision agriculture. |
| **Main Areas of Activity:** | • Studies on crop management (rotation, no-tillage, mineral nutrition, weeds etc.) to improve rainfed field crops.<br>• Precision agriculture: developing new fertilization managements, that include decision support systems to increase wheat grain quality, site specific managements and variable rate application, based on GIS layers, and multi/hyper spectral remote sensing suited for semi arid regions.<br>• Grain quality parameters as gluten index and health components. |
| **Brief description of proposed project:** | Biotic and abiotic stress sensing, decision support systems to increase wheat grain yield and quality |
| **Keywords:** | Wheat,<br>Phenomics,<br>Multi spectral RS,<br>Proximal sensing. |

| Name: | Borisover Mikhail |
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| Short Bio: | Senior Research Scientist (Grade A+, equivalent to Full Professor). Ph.D in Physical Chemistry (Kazan State University; Russia). Experience in Soil and Environmental Chemistry. Associated Editor of Journal of Environmental Quality. Publications: 99 papers in peer-reviewed Journals, 3 book chapters. |
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| **Main Areas of Activity:** | Natural organic matter in soil and aquatic systems: composition, structure and functions. Use of excitation-emission fluorescence and infra-red spectroscopies for characterization of organic matter. Sorption interactions of chemicals with soils and soil components. Disinfection byproduct formation and the associated toxicity of water. Use of fluorescence spectroscopy for characterization of water quality in multiple applications, including drinking water, groundwater, treated wastewater and water used for irrigation |
| **Brief description of proposed project:** | Use of excitation-emission fluorescence spectroscopy supported by machine learning algorithms for characterization and monitoring microbial quality of water and air in various agroenvironments. |
| **Keywords:** | Microbial contamination; water quality; air pollution; emission; tryptophan fluorescence; humic substances; machine learning; PARAFAC; PLS |

| Name: | Charuvi Dana |
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| **Short Bio:** | My research background and work revolve around the photosynthetic system and various aspects related to its biogenesis, three-dimensional structure, adaptation to different light conditions, as well as protection of the photosynthetic apparatus during abiotic stresses. We are also engaged in projects involving supplemental illumination for crop improvement. |
| **Main Areas of Activity:** | Light-induced proteins for photo-protection of the photosynthetic apparatus<br><br>Intra-canopy illumination for improving pepper fruit yield<br><br>Improving the response to frost conditions (cold & high light stress) of avocado trees<br><br>Chloroplast differentiation |
| **Brief description of proposed project:** | Light manipulation for crop improvement<br><br>Chlorophyll-fluorescence-based phenotyping |
| **Keywords:** | photosynthesis<br>abiotic stress<br>light-induced proteins<br>LED inter-lighting / intra-canopy illumination |

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| **Short Bio:** | Yafit Cohen is a senior research scientist at the Institute of Agricultural Engineering at ARO. She possesses a B.A. and Ph.D. in geography from Bar-Ilan University, with specialization in Geographical Information Systems and Remote Sensing. She served as a post-doctoral fellow at the Technion, Haifa during 2002 and specialized in remote sensing for land-use recognition and mapping . <br><br> Since 2003 she is a research scientist in the Institute of Agricultural Engineering at ARO. She is an adjunct faculty at the Faculty of Agriculture, Hebrew University, and teaches GIS . <br><br> Her scientific main interests are 1) Remote-sensing for precision agriculture practices especially for irrigation and fertilization; and 2) spatio-temporal analysis of insects and weeds distribution in agricultural environments like Fruit flies, Red-palm-weevi and Egypian Broomrape. <br><br> During the past 15 years, she served as a member of a number of scientific committees, co-chaired the 10th European conference in precision agriculture, has served as a guest editor of a special issue of the journal of Biosystems Engineering, and serves today as a member of the editorial board of the journal Remote Sensing. |
| **Main Areas of Activity:** | Precision agriculture, thermal and hyper-spectral imaging, Soil and plant sensors, GIS, spatio-temporal analysis, spatial decision support systems for irrigation and integrated pest management, automatic monitoring of insects. |
| **Brief description of proposed project:** | Fusing aerial thermal imaging with satellite multi-spectral imaging to estimate and map water status variability for variable rate irrigation. |
| **Keywords:** | Precision agriculture, <br> thermal and hyper-spectral imaging, <br> Soil and plant sensors, <br> automatic monitoring of insects. |

| Name: | Cytryn Eddie |
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| Short Bio: | Dr. Cytryn's research centers on various aspects of environmental microbiology and microbial ecology. He is especially interested in plant-microbe interactions and environmental and agricultural dimensions of antimicrobial resistance (AMR).<br><br>For the past ten years, his lab has investigated impacts of treated wastewater irrigation, animal husbandry and aquaculture on AMR, using isolation and culture independent methods to delineate microbial communities and antibiotic resistance genes. This includes application of next-generation sequencing based metagenomic approaches coupled to advanced bioinformatic pipelines.<br><br>He is active in several European research networks including COST Action ES1403- "New and emerging challenges and opportunities in wastewater reuse" and is the coordinator of the recently funded EU-PRIMA consortium "Decision support-based approach for sustainable water reuse application in agricultural production (DSWAP)".<br><br>Dr. Cytryn has received numerous national and international grants and prizes. He has close to 50 publications in high impact peer-reviewed journals, and published six book chapters. |
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| **Main Areas of Activity:** | <ul><li>Antibiotic resistance in agroecosystems</li><li>Wastewater microbiology</li><li>Plant root-microbe interactions</li><li>Biocontrol of soilborne plant pathogens</li></ul> |
| **Brief description of proposed project:** | Open to collaboration on projects focusing on:<br><br>- Antibiotic resistance in the environment<br>- Wastewater treatment<br>- Plant-bacterial interactions<br>- Biocontrol of soilborne pathogens |
| **Keywords:** | Antibiotic resistance,<br>resistome,<br>microbiome,<br>plant root,<br>rhizosphere,<br>biocontrol |

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| **Short Bio:** | Haya Friedman acted as the Head of the Department of Postharvest Science in Volcani Center until June 2019.<br>She completed her B.Sc. at Tel Aviv University, her M.Sc. at Weizmann Institute in Life Sciences and her Ph.D. at Hebrew University of Jerusalem in Horticulture.<br><br>She is an expert on physiology of postharvest fruit ripening |
| **Main Areas of Activity:** | a. Molecular biology of fruit ripening<br>b. Preharvest factors affecting fruit ripening<br>c. Physiological diseases of postharvest |
| **Brief description of proposed project:** | a. Identification of pre developed pathogen infection for sorting out fruit prone for the development of postharvest infection during the supply chain.<br>b. Identification of biological age for sorting fruit with different time of ripening. |
| **Keywords:** | Hyperspectral camera,<br>fruit ripening,<br>sorting,<br>pathogen identification |

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| **Short Bio:** | Dr. Klapp, Ph.D. EE (physical electronics), is the PI of the Agro-Optics and Sensing Lab, the lab confronts acquisition problems originate from inspection in precision agriculture and Interaction of light and vegetation/water and microbiology in agriculture environmental processes. |
| **Main Areas of Activity:** | Research interests include; computational imaging, passive and active optical design, super-resolution, stabilization low cost radiometric thermal imaging, fluorescence spectroscopy, hyperspectral spectroscopy as well as machine learning, inverse problems, and machine vision algorithms and optimization. |
| **Brief description of proposed project:** | 1. We are looking for a partner for mutual submission for the upcoming Joint German-Israeli Water Technology Research Program. On our side, we would like to extend our work in fluorescence measurements for bio-activity identification on flow system. Our work includes Optical engineering and algorithms for data acquisition and content identification.<br>2. We have developed low computation capabilities for CNN super-resolution schemas for Infrared, We are open for collaboration in the upcoming h2020 space for SR for satellite imagery.<br>3. We are interested in taking a roll of developing sensing configuration and algorithms for robotics vision.<br><br>Following the above, the group is working on the adaptation of various optical systems to measurement under environmental conditions (optics and algorithms).  So that we are generally, open for collaboration in these fields in h2020 program and similar. |
| **Keywords:** | Environmental Imaging, Computational Optics, Sensing and Acquisition, Algorithms, Machine learning, Machine vision, AI in data acquisition. |

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| **Short Bio:** | I hold a B.Sc and M.Sc in crop protection from the Hebrew University of Jerusalem. My Ph.D from the Department of Mapping and Geo-Information Engineering in the Technion focused on using 3-D image-based models for weed detection and characterization. The overall objective of my research is to develop Precise Weed Management (PWM) and\or Integrated Weed Management (IWM) programs and to promote alternative weeding tactics. I employ different sensors and imaging techniques to monitor weeds and characterize their growth status under various conditions. By doing so I hope to minimize the use of herbicides and reduce herbicide-dependence of current weed control systems. |
| **Main Areas of Activity:** | Precise weed management (PWM) and precision agriculture<br>Sensing methodologies for PWM<br>3D plant modelling and phenotyping<br>Non chemical weed control<br>Physical and thermal weed control methods<br>Integrated weed management |
| **Brief description of proposed project:** | Using hyperspectral sensors for weed detection and classification and phenotyping.<br>Using multi\hyperspectral sensor acquired from proximal and remote platforms for early detection of herbicide injury and resistance weed populations.<br>Integrating spectral and morphological features for water status detection in chickpea. |
| **Keywords:** | Data fusion,<br>Hyperspectral data,<br>Precise weed management,<br>Weed detection,<br>Remote sensing,<br>3-D models |

| Name: | Lichter Amnon |
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| **Short Bio:** | 1990-1995: PhD from Tel Aviv University<br><br>1995-1997: Postdoc at Oregon State University<br><br>1998-2020: Researcher in the Department of Postharvest Science in the Volcani Center<br><br>2011-2013: Department head<br><br>2017-2019: Institute head |
| **Main Areas of Activity:** | Postharvest quality and storage technologies for grapes and palm dates. |
| **Brief description of proposed project:** | During postharvest storage fruits and vegetables can suffer from compromised surface integrity. This can lead to physiological and pathological disorders that will lead to waste. Preliminary results suggest that this loss of integrity can be detected non-destructively by optical equipment.<br>It is proposed to develop this concept using grapes and tomato as a model system. |
| **Keywords:** | Postharvest,<br><br>waste,<br><br>grapes,<br><br>tomato |

| Name: | **Paz-Kagan Tarin** |
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| Short Bio: | My agricultural research focuses on developing new innovative approaches for precision agriculture (PA), using remote sensing and additional information for site-specific management (SSM) that is based on observing, measuring and responding to inter and intra-field variability in agricultural fields. The goal of precision agriculture research is to define decision support systems (DSS) for management in order to optimize returns on inputs while preserving resources for sustainable management. We use agro-informatics approaches, including remote sensing from different platforms (satellite, airborne, UAV, and ground sensors) and different sensors (i.e., LiDAR, hyperspectral, multispectral and thermal). We are using optics and photonics in agriculture including optical measurements of plant and soil parameters, Identification of plant conditions, determination of growth factors as water content, LAOI and water status, analysis of plant biomass and quality, analysis of soil quality and detection of plant nutritional status. We apply machine learning and artificial intelligent (AI) algorithms, spatial statistics and time series analysis for developing precision agriculture management. |
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| **Main Areas of Activity:** | Optical measurements of plant and soil parameters (Spectroscopy) Identification of plant conditions Determination of growth factors as detection of plant nutritional status Analysis of plant biomass and quality Analysis of soil quality 3D-LiDAR models and Imaging spectroscopy |
| **Brief description of proposed project:** | Detection of plant nutritional status based NIRS spectroscopy State-of-the-art AI technologies for precision agriculture Develop innovative photonics systems based on 3D LiDAR and imaging Spectroscopy |
| **Keywords:** | remote sensing, spectroscopy and chemometrics, optics and photonics, imaging spectroscopy, 3D LiDAR, machine learning, artificially intelligent and big data |

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| **Short Bio:** | Victor Rodov holds a Ph.D. degree in Plant Physiology. In 1990, he joined the Agricultural Research Organization (ARO) – The Volcani Center, Israel. Currently he is a research team leader at the Department of Postharvest Science of the ARO. His experience involves postharvest physiology, biochemistry and technology with special interest in fresh-cut produce, bioactive antimicrobial plant secondary metabolites; modified-atmosphere and modified-humidity packaging, including biodegradable packaging materials and edible coatings; health-beneficial phytonutrients and functional foods of plant origin; agro-industrial wastes utilization, and food nanotechnology. He is a member of the Editorial Advisory Board of "Postharvest Biology and Technology" and published about 130 research papers, including 14 book chapters and invited reviews. |
| **Main Areas of Activity:** | Postharvest physiology and technology <br> Food science |
| **Brief description of proposed project(s):** | Three topics within my scope seem to be relevant to agro-photonics area: (a) Improvement of produce quality (nutritional, visual, microbiological) by postharvest photobiological treatments. See for example Rodov et al., 2010. *J Agric Food Chem. 58*, 9071-9076; Rodov, et al., 2012. *Postharvest Biol. Technol, 68*, 43-46. <br> (b) Antimicrobial effects using natural materials (free or surface-bound) as photosensitizers. See for example Shlar et al., 2017. *J Proteomics, 160*, 8-20; Shlar et al., 2018. *Colloids and Surfaces B: Biointerfaces, 164*, 379-387. <br> (c) Early detection of postharvest damages or disorders onset before they become irreversible (chilling injury, hypoxic injury, $CO_2$ injury) using photonic approaches: bioluminescence, fluorescence (in particular, chlorophyll fluorescence, etc.). |
| **Keywords:** | (a) Postharvest; produce quality; photobiological treatment; illumination; visible light; UV; <br> (b) Antimicrobial; photodynadics; natural photosensitizers; solution; surface binding; active surfaces. <br> (c) Postharvest disorders; chilling injury; hypoxia; $CO_2$ damage; presymptomatic detection; bioluminescence; fluorescence; multispectral; hyperspectral. |

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| **Short Bio:** | 1982 B.Sc. Technion, Israel Institute of Technology, Faculty of Agricultural Engineering.<br>1989 M.Sc. in Agricultural Machinery at The Technion, Israel Institute of Technology, Faculty of Agricultural Engineering.<br>2000 Ph.D. in Agricultural Machinery at The Technion, Israel Institute of Technology, Faculty of Agricultural Engineering.<br><br>1976-1983, Practical Engineer, the Institute of Agricultural Engineering, A.R.O. the Volcani Center, Israel<br>1983-1988, Promoted to Research Associate at the A.R.O. the Volcani Center, Israel.<br>1988-1989, Promoted to Scientist (Rank C) at the A.R.O. the Volcani Center, Israel.<br>1996, Promoted to Senior Scientist at the (Rank B) A.R.O. the Volcani Center, Israel.<br>2001-2002, Head, Department of postharvest technologies and quality assurance Institute of Agricultural Engineering, A.R.O. the Volcani Center, Israel<br>2002-2004, Head, Department of information and mechanization engineering systems, Institute of Agricultural Engineering, A.R.O. the Volcani Center, Israel<br>2004-2010, Director, Institute of Agricultural Engineering, A.R.O .<br>the Volcani Center, Israel<br>2007, Promoted to Senior Scientist (Rank A) at the A.R.O. the Volcani Center, Israel<br>2013-2017, Head, Department of information and mechanization engineering systems, Institute of Agricultural Engineering, A.R.O. the Volcani Center, Israel<br>2016, Promoted to Highest Senior Scientist (Rank A+) at the A.R.O. the Volcani Center, Israel<br>2020 Emeritus researcher |
| **Main Areas of Activity:** | Non-Destructive Testing (NDT) methods and sensors; Near infrared spectroscopy; RF measurements; Postharvest Engineering; Quality of agricultural products; Sorting and separation of agricultural products; |
| **Brief description Of proposed project:** | Using spectroscopy methods such as FTIR, RAMAN, NIRS, for rapid detection of food borne pathogens. |
| **Keywords:** | NIRS, RAMAN |

| Name: | Sela (Saldinger) Shlomo |
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| **Short Bio:** | Senior Research Scientist in Volcani, Agricultural research Organization, Israel. Ph.D in Clinical Microbiology (Hebrew University-Hadassah Medical school; Jerusalem, Israel). Post-doctorate training at Washington University, St. Louis, Senior Lecturer at the Sackler School pf Medicine, Tel-Aviv University. Experience Microbial-food safety. Editorial board member of the International Journal of Food Microbiology. Publication: 94 papers in peer-reviewed Journals, 6 book chapters. |
| **Main Areas of Activity:** | Microbial food safety, water contamination; survival of human pathogens in the agro-food environment; desiccation tolerance of Salmonella; Salmonella-plant interactions; Bio-Control of Food- and water-borne pathogens in poultry and in fresh produce |
| **Brief description of proposed project:** | Use of excitation-emission fluorescence spectroscopy supported by machine learning algorithms for characterization and monitoring microbial quality of water and air in various agroenvironments. |
| **Keywords:** | Microbiology, food and water safety, human pathogens, Microbial contamination; water quality; bacterial stress response Survival, desiccation, microbe-plant interactions |

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| **Short Bio:** | Environmental engineer/ Microbial ecologist, working on Microbial problems related to the quality and safety of Aquaculture products. |
| **Main Areas of Activity:** | My two main areas of activity are:<br>• Developing phage-biocontrol Of fish pathogens to reduce the use of prophylactic antibiotics,<br>• Detection and elimination of harmful cyanobacterial Blooms in freshwater aquaculture and algal bioreactors |
| **Brief description of proposed project:** | Together with **Dr. Zeev Schmilovich** at the institute of Agricultural engineering, I am developing a Raman-spectroscopy based tool for monitoring harmful cyanobacterial blooms in freshwater Aquaculture and in bioreactors for growing spirulina and other Microalgae. |
| **Keywords:** | Harmful cyanobacteria;<br>Raman spectroscopy;<br>Aquaculture;<br>Spirulina;<br>Cyanotoxins |

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| **Short Bio:** | Vast multidisciplinary expertise in nanomaterials, semiconductors, microfluidics, photonics, and biological interfaces for biomedical and environmental monitoring applications. |
| **Main Areas of Activity:** | The Biosensors and Nanoengineering lab is focused on the development of novel biosensors/bioassays that will transform from a laboratory-based research into a real on-site "lab-on-chip" for addressing problems in fields of agriculture, animal diagnostics, food safety and environmental monitoring and detection.<br><br>We currently working on heavy metals, mycotoxins, neurotoxins (i.e., botulinum), specific bacteria strains detection in real Matrices (water, milk, plasma, milk). We're also developing combined spectroscopic platforms (refractometry and SERS – all-in-one), using diverse NPs for signal enhancement. |
| **Brief description of proposed project:** | 1. Label-free optical biosensors based on nanomaterials, nanoparticles and thin-films.<br>2. Combined sensing techniques based on a single-device platform (all-in-one) for agricultural applications.<br>3. Rapid bioassays for monitoring environmental pollutants (heavy-metals, pharmaceuticals, pesticides, hormones, toxins).<br>4. Multifunctional nanoparticles for early diagnosis of animal diseases, field crops quality control and food safety. |
| **Keywords:** | Optical sensing techniques, analytical instruments development, real-time detection, biosensors, bioengineering, on-site monitoring, heavy metals, pathogenic targets, toxins, uv-vis range, lab-on-chip |