

**Sustainable Water Management
Doctoral Programme (Water4All)**



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Title of the PhD Project	Artificial intelligence algorithms to optimize a trans-disciplinary water management system: modeling and experimental research
Acronym	ELE-6
Research Fields of the Project	Fiber optical sensor systems for sustainable water management
Keywords	Fiber optics, machine learning algorithms, groundwater management
Host Institution, Department and Campus Location	İzmir Institute of Technology, Electrical-Electronics Engineering Department, Urla, İzmir
PhD Awarding Institution and Graduate Programme	İzmir Institute of Technology, Graduate School, PhD in Electronics Engineering
Name and Affiliation of Main Supervisor	Kıvılcım YÜKSEL ALDOĞAN, Associate professor (İZTECH)
Name and Affiliation of Co-Supervisors	Abdurrahman Gümüş, Assistant professor (İZTECH) Yalın Bastanlar, Professor (İZTECH)
Research Environment and Infrastructure	<p>The İzmir Institute of Technology (İZTECH) has been distinguished as “one of the Top 5 Research Universities” out of 200+ higher education institutions in Türkiye, ranking first in terms of the number of peer-reviewed articles per faculty member.</p> <p>One of the strategic goals of İZTECH is to advance its position to a leading academic institution in water research in European Research Area. İZTECH Campus is in Urla, İzmir and has an area of 232.30 hectares of land (the third largest campus area in Türkiye).</p>



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	<p>Being an English medium university, IZTECH currently has Engineering, Science, and Architecture faculties with 19 departments (engineering 10, science 5 and architecture 5), with 18 undergraduate, 29 master's (9 interdisciplinary) and 15 doctorate (4 interdisciplinary) programs in 19 majors. IZTECH has 354 laboratories, 80% of which are for R&D purposes and 20% of which are for educational purposes. All laboratories contain the appropriate technology for education, teaching and research in various fields. Importantly, the Integrated Research Center (IRC) of IZTECH is one of the most-equipped and competent research centers in Türkiye, located on 6,250 m² area. IRC incorporates eight different Application and Research Centers (ARCs) including Environmental Development ARC, Geothermal Energy ARC, Biotechnology and Bioengineering ARC, National Mass Spectrometry ARC, Wind Energy Meteorology ARC and Continuing Education Center. The equipment and analysis portfolio are accessible through a website that was designed considering online-shopping perspective.</p> <p>Furthermore, the academic supervisors of ELE-2 have their own laboratories, namely FiSENSLAB, MIRALAB and CVRG that will be involved in the project.</p> <p>The Fiber Optic Metrology and Sensor Applications Laboratory (FiSENSLAB, https://eee.iyte.edu.tr/en/fiber-optic-sensors-lab/) was established in 2012 as a complementary part of the ongoing research at the Electrical and Electronics Engineering Department of IZTECH on the photonics domain. Specific research areas focused on at FiSENS-LAB include design and implementation of optical fiber reflectometry techniques, Distributed Optical Fiber Sensors (DOFS), Fiber Bragg Grating sensors (FBG), Passive Optical Networks (PON), and sensor data analysis using machine learning algorithms.</p> <p>The Machine Intelligence Research and Applications Laboratory (MIRALAB) at Izmir Institute of Technology, Türkiye, is dedicated to exploring the frontiers of artificial intelligence, with a particular focus on sequential data analysis and computer vision. MIRALAB is engaged in developing advanced AI methodologies, including transformers, diffusion-based models, and multimodal systems, by focusing on the application areas of optical sensors, biosensors, medical image understanding, facial expression analysis, wearable devices and digital health.</p> <p>The Computer Vision Research Group (CVRG, cvrg.iyte.edu.tr) at Izmir Institute of Technology targets to conduct research on the cutting-edge topics of applying AI and machine learning techniques for visual data such as: Visual object detection/classification, visual localization, vision for autonomous driving and ADAS, 3D reconstruction from images, object tracking, vision for robotics.</p>
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<p>Scientific Context of the Project</p>	<p>Groundwater plays an important role by serving as irrigation source during dry seasons and dry years when the surface water resources is insufficient to satisfy irrigation demand. Groundwater may also be the main source of irrigation water in areas which has productive aquifers where the surface water resources are limited. Rates of groundwater recharge in these semi-arid and arid regions are low such that, in the absence of alternative sources of water, groundwater withdrawals can exceed aquifer recharge and can result in depletion. Aquifer depletion has been reported for many semiarid and arid regions world-wide and can be attributed to agricultural withdrawals. The installation and maintenance cost of current monitoring networks together with insufficient planning and management approaches result in an actual irrigation performance far from being optimized and sustainable. Excessive use of groundwater for agricultural purposes and the consequences of this practice (e.g. depletion of groundwater resources, water quality degradation, waste of energy...) should be avoided by applying novel trans-disciplinary management paradigm supported by smart water monitoring systems.</p> <p>The main aim of the project is bridging the gap between potential and actual irrigation performance using innovative trans-disciplinary management approach combined with smart measurement and monitoring technologies. Transdisciplinarity, being the key proposition of the Project, defines a type of scientific activity and knowledge production that is different from the traditional disciplinary and interdisciplinary scientific activities since it incorporates processes, methodologies, knowledge and goals of stakeholders from science, industry, and politics.</p>
<p>Brief Workplan</p>	<p>0 – 2 years: PhD candidate will take classes from partner universities</p> <ul style="list-style-type: none"> Analysis of the state of the art Requirement analysis Simulation of the sensor interrogation system Fiber optic lab trainings



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	<p>0.5 – 2.5 years: Data collection capability improvement with fiber optic sensors. Noise modelling and analysis.</p> <p>1.0 – 4 years: Implementing the fiber optic sensors and tools specific for the corresponding Ph.D. project.</p> <p style="padding-left: 40px;">Comparison between simulated and experimental data.</p> <p style="padding-left: 40px;">Secondments visits.</p> <p style="padding-left: 40px;">Intersectoral mobility (outside plant trials).</p> <p style="padding-left: 40px;">Congress and article publishing.</p> <p>1.0 – 4 years: Developing and implementing artificial intelligence algorithms for the analysis of fiber optic sensors specific for the corresponding Ph.D. project</p> <p>3.0 – 4 years: Thesis report, dissemination activities.</p>
<p>Innovative Aspects of the Project</p>	<p>Our project proposal will provide a new combined innovative model to bridge the gap as well as close to irrigation performance to optimum. This will be applied in a suitable groundwater irrigated area with low irrigation ratio.</p> <p>The innovative aspect is raising awareness with applicable innovative solutions. We will put into practice an implementation of technology and problem-solving approach in between science, technology, and society.</p> <p>Trans-disciplinarily is defined as a specific type of knowledge production that deals with relevant, complex societal problems and organizes processes of mutual learning between agents from the scientific and the non-scientific world. Groundwater management is considered a typical object of transdisciplinary research. Therefore, project proposal has an innovative potential. This is due to the requiring joint problem solving between science, technology, and society.</p>

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Training Opportunities of the Project	<p>Doctoral schools and courses from the leading academic institutions in Türkiye, namely, Izmir Institute of Technology (IZTECH-beneficiary) in İzmir, İstanbul Technical University (İTÜ) in İstanbul, Gebze Technical University (GTU) in Kocaeli, and Middle East Technical University (METU) in Ankara.</p> <p>Research Laboratories of the co-advisors (FiSENS, MIRALAB, CVRG)</p>
Interdisciplinary Aspects	<p>This project brings together complementary expertise of a diverse group of researchers from 5 leading universities working towards Sustainable Water Management (SWM) in Türkiye to offer unique inter-disciplinary and inter-sectoral research and training opportunities for Doctoral Candidates.</p>
Intersectoral Mobility <input type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	NA
Intersectoral Mobility <input type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	NA
International Academic Secondment	NA

Main Supervisor	
Brief CV	<p>Assoc. Prof. Dr. Kivilcim YÜKSEL ALDOGAN</p> <p>E-mail: kivilcimyuksel@iyte.edu.tr</p> <p>Academic Degrees</p>



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	<p>Ph.D. Electromagnetism and Telecommunications, University of Mons, Belgium 2011</p> <p>M.Sc. Electromagnetism and Telecommunications, University of Mons, Belgium 2006</p> <p>M.Sc. Electronics Engineering, Ege University, Türkiye 2000</p> <p>B.Sc. Electronics Engineering, Dokuz Eylül University, Türkiye 1995</p> <p>Professional Networks</p> <p>Google Scholar: https://scholar.google.com/citations?user=rq9hCjsAAAAJ&hl=tr</p> <p>ResearchGate: https://www.researchgate.net/profile/Kivilcim-Yueksel</p> <p>Scopus: https://www.scopus.com/authid/detail.uri?authorId=24831988400</p> <p>ORCID: https://orcid.org/0000-0003-1512-3022</p>
Co-supervisors	



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Brief CV	<p>Assist. Prof. Dr. Abdurrahman GÜMÜŞ</p> <p>E-mail: abdurrahmangumus@iyte.edu.tr</p> <p>Academic Degrees</p> <table><tr><td>Ph.D. Electrical and Computer Engineering, Cornell University, USA</td><td>2014</td></tr><tr><td>M.Sc. Electrical and Computer Engineering, Cornell University, USA</td><td>2010</td></tr><tr><td>B.Sc. Electrical and Electronics Engineering, Istanbul University, Türkiye</td><td>2005</td></tr></table> <p>Professional Networks</p> <p>Google Scholar: https://scholar.google.com.tr/citations?user=Hc7A4o0AAAAJ&hl=en</p> <p>Scopus: https://www.scopus.com/authid/detail.uri?authorId=35315599800</p> <p>ORCID: https://orcid.org/0000-0003-2993-5769</p>	Ph.D. Electrical and Computer Engineering, Cornell University, USA	2014	M.Sc. Electrical and Computer Engineering, Cornell University, USA	2010	B.Sc. Electrical and Electronics Engineering, Istanbul University, Türkiye	2005
Ph.D. Electrical and Computer Engineering, Cornell University, USA	2014						
M.Sc. Electrical and Computer Engineering, Cornell University, USA	2010						
B.Sc. Electrical and Electronics Engineering, Istanbul University, Türkiye	2005						
Brief CV	<p>Prof. Dr. Yalın BAŞTANLAR</p> <p>E-mail: yalinbaskanlar@iyte.edu.tr</p> <p>Academic Degrees</p> <table><tr><td>Ph.D. Informatics Institute, Middle East Technical University, Türkiye</td><td>2009</td></tr><tr><td>M.Sc. Informatics Institute, Middle East Technical University, Türkiye</td><td>2005</td></tr><tr><td>B.Sc. Civil Engineering, Middle East Technical University, Türkiye</td><td>2001</td></tr></table> <p>Professional Networks</p> <p>Google Scholar: https://scholar.google.com.tr/citations?user=3WTNhHYAAAAJ&hl=tr&oi=ao</p> <p>ResearchGate: https://www.researchgate.net/profile/Yalin-Baskanlar</p> <p>ORCID: https://orcid.org/0000-0002-3774-6872</p>	Ph.D. Informatics Institute, Middle East Technical University, Türkiye	2009	M.Sc. Informatics Institute, Middle East Technical University, Türkiye	2005	B.Sc. Civil Engineering, Middle East Technical University, Türkiye	2001
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