BRIDGING ARTIFICIAL INTELLIGENCE AND HEALTHCARE: A FULBRIGHT JOURNEY IN THREE CONTINENTS

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ABSTRACT

From the vibrant cityscape of Ankara to the corridors of Harvard Medical School, and then to Dublin's historical allure, my Fulbright journey mapped Artificial Intelligence (AI)'s impact in healthcare across diverse landscapes. This worldwide exploration illuminated both the promise and the complex challenges that AI brings to the medical field. The Fulbright experience broadened my understanding of the possibilities and pitfalls at the intersection of AI and healthcare, strengthening my commitment to navigate these advancements responsibly.

Keywords: Harvard • artificial intelligence • biotechnology • cells •cultural exchange •healthcare

A FULBRIGHT JOURNEY COMMENCES: UNRAVELING THE LAYERS OF CURIOSITY

My initial fascination with technology, driven by a deep curiosity about the world, became the foundation for my studies. Fostering my enthusiasm further, I extended my academic journey at Bilkent University, Ankara. There, I engaged in my MSc and PhD in Electrical and Electronics Engineering, expanding my comprehension into multidisciplinary studies. My participation in the international scientific community took a significant leap when I was nominated as a Young Scientist at the 66th Lindau Nobel Laureates Meeting in Lindau, Germany in 2016. This annual event brings together Nobel Laureates and promising young scientists from various disciplines to foster intellectual exchange. The 2016 meeting specifically focused on the fields of physics. Nobel Laureates presented lectures, and interdisciplinary panel discussions were held to engage in deep scientific dialogue. This invaluable experience served as a catalyst for my subsequent Fulbright chapter of my journey, providing me with unparalleled insights and networking opportunities that shaped my research endeavours.

MOVING FORWARD WITH THE FULBRIGHT EXPERIENCE: EXPLORING NEW IDEAS IN BOSTON

The Fulbright Doctoral Research Fellowship, awarded in 2017-18, presented a unique chance to further my research at Harvard Medical School, one of the world's leading medical institutions. As a Fulbright fellow at the Wellman Center for Photomedicine, Massachusetts General Hospital, I engaged in a pioneering project that blended image acquisition, image processing, data analysis, and life sciences, under the supervision of Prof. Seok Hyun (Andy) Yun. In this context, our goal was to identify cellular information at the single-cell level for high-throughput, label-free classification and detection. The potential advantages of this research were profound: it could disrupt the diagnostic research of anemia and cancer cells, specifically for in-vitro studies (see notes).

In the laboratory, I collaborated with one postdoctoral fellow from the clinical side and another from the field of applied physics, to develop ideas for my PhD project. During my Fulbright program, our research findings have been showcased at several notable conferences. These included the National Radio Science Meeting in Boulder, hosted by the U.S. National Committee (USNC) for the International Union of Radio Science (URSI); the Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Antennas and the USNC-URSI Radio Science Meeting in Boston; the Sigma Xi Student Research Conference in Raleigh, North Carolina; and the Gordon Research Conference on Lasers in Micro, Nano, and Bio-systems in Waterville Valley, New Hampshire. My contributions included both oral and poster presentations, as well as participation in student paper competitions. The scholarly outputs from these events have been published in IEEE Xplore. This period of rigorous research culminated in receiving the 2017/18 IEEE Antennas and Propagation Society (IEEE AP-S) Doctoral Research Grant – related to my PhD project about how single biological cells scatter electromagnetic waves in realistic scenarios. This award, given to only a few individuals each year, showed the importance of our research contributions to the IEEE community.

During my Fulbright tenure in the US, I had the privilege of meeting leading researchers at conferences and workshops, fostering valuable collaborations. For instance, I participated in the 2018 Fulbright Global Health Innovation Seminar in Atlanta, Georgia, US. A visual representation of my attendance and engagement at this seminar can be seen in an accompanying figure captioned: "Polat, along with fellow Fulbright scholars, at the 2018 Fulbright Global Health Innovation Seminar held in Atlanta, Georgia." The seminar focused on strategies to reduce inequality and enhance public health. These themes overlap with my research, which aims to identify cellular information at a single-cell level for high-throughput, label-free classification and detection. Notable figures at the seminar included Dr. Michael Eriksen, a renowned

expert in global health and tobacco control, and Dr. Richard Rothenberg, a prominent figure in infectious disease epidemiology. Interacting with leadingscientists and fellow Fulbright researchers during this event greatly enriched my career development plan.

In addition to the professional aspects, the emphasis on international exchange by the Fulbright program has been pivotal in providing a global perspective. This experience has allowed me to identify both differences and similarities in research methodologies across various regions. For instance, researchers in Europe are making significant strides in the fields of cell biology and biophysics, employing state-of-the-art techniques similar to those used in the US (see notes). However, the rate of progress and the application of these advanced methodologies are often influenced by economic circumstances. The disparities underline the importance of a global effort to foster and support scientific research, regardless of the economic status of the country. Advancements in one part of the world can, and should, stimulate progress in others. This belief underscores the value of the Fulbright program that facilitates the exchange of ideas and encourages collaboration between researchers from diverse backgrounds and regions.

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Engaging with researchers from diverse backgrounds and cultures broadened my horizons and exposed me to a wide range of innovative ideas and approaches. These interactions stimulated my intellectual curiosity and pushed me to think beyond conventional boundaries. My networking journey began at workshops, seminars, and conferences where I interacted with researchers in fields related to my own. I reached out to these researchers to share my perspectives and potential ideas related to their areas of study, serving as an initial step toward possible collaboration. Upon identifying mutual interests, we initiated further dialogues to refine our collaborative objectives. Through continued discussions, we fine-tuned workflows and project scopes, thereby transforming casual academic encounters into productive partnerships. By engaging in dialogues and forming collaborations with leading scientists in healthcare, I acquired critical insights into state-of-the-art research methods and furthered my own research endeavors. During my Fulbright program, I developed a strong professional network through ongoing discussions with leading healthcare researchers. This network has been instrumental in offering consistent support, mentorship, and collaborative opportunities, enriching both my Fulbright experience and my career thereafter.

Indeed, the Fulbright experience has provided me with a deep appreciation of the importance of establishing a symbiotic relationship between research and real-life challenges. I have learned to see the immense value in bridging the gap between academic research and practical applications. To provide concrete examples, during my Fulbright tenure, I developed collaborative

pathways with Harvard and MIT. This led to the opportunity to receive funding from Enterprise Ireland and the European Union (EU) through the Marie Skłodowska-Curie Co-Fund Scheme. This EU project has enabled me to broaden my research scope into developing AI algorithms that are specifically designed to solve real-world problems, particularly focusing on generative AI.

ENCOUNTERING ARTIFICIAL INTELLIGENCE: DISCOVERING POTENTIAL AND PITFALLS IN HEALTHCARE

During my Fulbright at Harvard, I developed a profound interest in the field of AI, particularly its potential impact on healthcare. The transformative potential of AI algorithms in healthcare is particularly compelling. These algorithms function by analyzing large datasets, such as medical records or imaging scans, to identify patterns and make predictions. For example, AI can assist in diagnosing illnesses earlier by scanning medical images for minute abnormalities that may be missed by the human eye. Similarly, they can aid in the development of personalized treatment plans by analyzing a patient's genetic dataset. As the technology matures, it holds promise to revolutionize patient care, making diagnostics and treatments more accurate, accessible and patient-centered healthcare system for the general population in the coming years. This intriguing capacity of AI has spurred my continued exploration in the field. To provide a concrete example of the transformative power of AI algorithms, please look at my research in developing advanced AI algorithms to enhance the stem cell manufacturing process (see notes).

The AI algorithms were designed to optimize the growth conditions in cell density and media environments, enhancing the yield and quality of the stem cells produced. This innovative approach could have a profound impact on regenerative medicine. For instance, improving the stem cell manufacturing process can lead to more effective treatments for a wide range of conditions such as Parkinson's disease, spinal cord injuries, and heart diseases (where stem cell therapies are showing promising results). In contrast to traditional methods, which often rely on fluorescent channel bio-markers and involve time-consuming image analysis, AI algorithms offer a more efficient approach. AI algorithms can analyze complex biological data from label-free images, streamlining the process and significantly reducing cellular analytics time. This has the potential to expedite diagnostics and other medical procedures by a substantial margin, including more precise diagnoses, personalized treatment plans, and improved patient outcomes. By eliminating the need for time-intensive steps in traditional bio-marker procedures, AI not only speeds up the process but also enhances its accuracy, making it highly impactful for current healthcare methodologies.

While the potential benefits of AI in healthcare are immense, it is essential to acknowledge the challenges associated with its integration into clinical practices. Questions regarding data security, algorithmic bias, preservation of human judgment, and accountability have emerged as significant areas of concern that require careful consideration. To ensure that AI in healthcare benefits all, addressing its constraints is crucial. One of the central points of my current research focuses on navigating the ethical dimensions of AI, particularly within the healthcare settings (see notes).

As natural language processing tech gets better, generative AI models like the generative pretrained transformer (GPT) series are emerging as powerful tools. However, a myriad of ethical considerations has emerged. How can we ensure that sensitive patient data used in AI healthcare systems is adequately protected? How do we eliminate biases in AI systems to prevent discrepancies in patient care and treatment? As AI becomes more prevalent, how do we maintain human involvement and judgment in patient care? Who bears the responsibility when AI-induced errors occur in medical settings? And most importantly, how do we construct an ethical and regulatory framework to manage AI in healthcare? These considerations must be addressed to ensure the responsible and ethical applications of AI in healthcare.

IMPLEMENTING AI FOR REAL-WORLD PROBLEM SOLVING: A GATEWAY TO INTERNATIONAL COLLABORATION

Taking these inquiries into consideration, I continued my research activities in Dublin, Ireland, where I received the funding through my collaboration with Harvard and MIT colleagues during the Fulbright journey. In Dublin, my research was backed by Enterprise Ireland and the EU through the Marie Skłodowska-Curie Career-FIT PLUS program, a European Commission initiative designed to promote transnational, intersectoral, and interdisciplinary mobility among experienced researchers. My project entitled "*DeepStain: Deep Learning for Cell Image Analysis*," is the result of a strategic partnership between ValitaCell & Beckman Coulter, an Irish biotech firm, and School of Computer Science & CeADAR, Ireland's Centre for Applied Artificial Intelligence at University College Dublin (UCD), Ireland.

This project allowed me to extend my research into developing AI algorithms tailored to solve real-world issues. I have been actively integrating these advanced AI algorithms to improve stem cell manufacturing processes. The potential implications of this research for the health sector are substantial and could potentially revolutionize the treatment of various conditions, including cancer, arthritis, and Crohn's disease. The long-term impact of these advancements has the potential to transform how these conditions are managed, providing new and more effective approaches to improve patient outcomes and quality of life.

Throughout my academic journey, I have actively engaged in discussions surrounding the ethical considerations of AI in healthcare. One notable international collaboration arose during my Fulbright program, where I had the privilege of working alongside Prof. Ali Fuat Kalyoncu in the field of Allergy and Immunology at Hacettepe University in Ankara, Turkey. This participation stems from my strong commitment to ensuring that technology remains aligned with human values and principles, without ignoring them in clinical settings. (see notes). The outcomes of this collaboration resulted in another significant publication and paved the way for a collaborative project with Dr. Begum Kalyoncu, a Fulbright Alumni, focusing on an AI project in the nutrition field.

By actively engaging in these discussions and collaborative projects, I aim to contribute to the development of ethical frameworks and responsible practices that guide the integration of AI into healthcare. Through interdisciplinary collaboration and a steady commitment to human-centered approaches, we can integrate the potential of AI while ensuring that it remains aligned with our values and serves the best interests of patients and society as a whole into our life.

LOOKING AHEAD: A GLOBAL VISION FOR ETHICAL AI IN HEALTHCARE

Even though I have gained invaluable insights into the practical applications of AI within this dynamic field, the ethical dilemmas persist. I believe that engaging in open discussions, implementing AI responsibly, and a commitment to human values are essential in successfully navigating these challenges. I am excited to continue on this path, with the knowledge and experiences I acquired during my Fulbright, and with a firm determination to strike a balance between technological progress and ethical considerations. Addressing these dilemmas is no easy task, and it would require a collective effort from researchers, healthcare professionals, policymakers, and society as a whole. However, I believe that through the cultivation of open and constructive discourse, a responsible approach, and a commitment to maintaining our shared human values, we possess the capacity to successfully navigate these challenges.

FINAL THOUGHTS: BALANCING DREAMS AND DILEMMAS

Through my academic journey, starting from Ankara and spanning continents, the Fulbright program's influence on my personal and professional growth is undeniable. Without the Fulbright experience that brought me from Ankara to Boston, I would never have been able to step inside a new point in my life. As I progress, I remain committed to making AI in healthcare not just a dream, but a reality that is beneficial for all regardless of social

boundaries – as one of the pillars of the Fulbright program. While challenges may lie ahead and the path may not always be easy, I am hopeful that each step forward brings us closer to a world where AI in healthcare becomes a reality that benefits all while upholding ethical standards and security.

This is a journey worth pursuing. As I reflect on my Fulbright experience and look towards the future, I am grateful for the opportunities it has provided and the long-lasting effect it has had on my career. These experiences have provided me with invaluable connections that continue to shape my current research studies and contribute significantly to my professional growth. Additionally, I am currently honored to be a member of the Advisory Board for the Turkish Nobel Community, where I provide mentorship to Junior researchers in high schools. I also actively engaged in mentoring undergraduate international students through the IEEE Engineering in Medicine & Biology Society – Student Mentoring program These roles allow me to advance the vision and mission of the Fulbright Association as an alumni member, giving back to the community and supporting the next generation of researchers. I am dedicated to persisting on this path, striving towards a future where AI in healthcare becomes a crucial instrument for enhancing lives globally.

Notes

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Polat, along with fellow Fulbright scholars, at the 2018 Fulbright Global Health Innovation Seminar held in Atlanta, Georgia.

BIOGRAPHY

Dr. Polat Goktas was awarded a Fulbright Doctoral Research Fellowship in 2017-18 at the Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School, Boston, US. At present, he is a Marie-Curie Research Fellow at the UCD School of Computer Science, and Ireland's Centre for Applied Artificial Intelligence, focusing on practical artificial intelligence solutions. His accolades include the 2016 Young Scientist Award at the Lindau Nobel Laureates Meeting, the 2017 IEEE AP-S Doctoral Research Grant as the top global PhD student, the 2020 Marie-Curie Individual Fellowship, the 2021 METU Serhat Ozyar Young Scientist of the Year Award, among others. He can be reached at polat.goktas@ucd.ie. His social media handles include Twitter: @PolatGoktass and LinkedIn: https://www.linkedin.com/in/polat-goktas-ph-d-29b24b58/