Research Talk Session I: 10:00 – 10:55 a.m.

Rapid and facile light-based approach to generate complex hydrogel patterns for organ-on-a-chip models
Ana Mora-Boza*, Adriana Mulero-Russe, Ankur Singh, Andrés J. García

Intestinal bowel disease (IBD) is a chronic immune-mediated disorder, comprising Crohn’s disease and ulcerative colitis and characterized by chronic inflammation of the gastrointestinal tract. An estimated 3.1 million adults in the US have been diagnosed with IBD, with annual costs exceeding $25 billion (Siddharth et al 2022). The unknown etiology of IBD, along with its heterogeneous and multifactorial nature, make essential the development of relevant and functional model platforms that enable the fundamental understanding of the disorder. Human intestinal organoids (HIOs) have enormous potential for IBD modeling, but their derivation in static three-dimensional matrices without perfusion can restrict their development and functionality. Currently, the fabrication of perfusable gut-on-a-chip platforms that include hydrogel matrices for HIOs culture, involve painstaking, time-consuming, and specific laser-based methodologies limited to natural matrices (Mitrofanova et al. 2022). Here, we propose a rapid and facile methodology to generate complex hydrogel structures to use in gut-on-a-chip platforms for IBD diagnostic, modeling, and drug screening applications. Our strategy employs ultraviolet photopolymerization of synthetic polyethylene glycol hydrogels using a photomask to generate complex patterns, including perfusable channels. This approach reduces preparation times from several hours to seconds and requires simple instrumentation. Moreover, the ability to use synthetic hydrogels provides tremendous flexibility and lowers regulatory burdens (U.S. Patent Application (8838/8839)). Our optimized hydrogel formulation provided a reduced swelling (≤10%), which was essential to maintain an excellent shape fidelity (~85%) of the developed features in the gut-on-a-chip device that demonstrated excellent perfusability. Single cells obtained from HIOs were seeded in the central lumen, showing surface coverage of 69±0.3% with a viability of 96±2% after 3 days of culture. Moreover, intestinal markers (e.g., CDX2, E-cadherin) were observed in the cultured cells in the devices, demonstrating that our gut-on-a-chip systems are suitable and accessible platforms for the development of more physiologically relevant intestinal organoids.
Research Talk Session I: 10:00 – 10:55 a.m. (continued)

Formulaic vs. Non-Formulaic Constructions in Second Language Writing
Leila Gholami*

Research in second language (L2) writing provides evidence for the beneficial role of drawing L2 learners’ attention to their non-target language use through written corrective feedback (WCF). Learner corpus research has predominantly examined learners’ errors involving non-formulaic constructions (i.e., single-word vocabulary, grammar, and spelling) in L2 writing. However, L2 learners’ erroneous use of formulaic constructions, comprising collocations, lexical bundles, idioms, and compounds has received scant attention in WCF studies. The present descriptive study examined the extent of L2 learners’ errors with formulaic vs. non-formulaic constructions in L2 writing and writing teachers’ WCF treatment of (non)formulaic errors. A total of 480 samples of writing written by 33 advanced adult English-as-a-foreign language (EFL) learners during one semester and 480 drafts of writing corrected through WCF by three EFL teachers constituted the corpus in this study. Written error episodes and WCF episodes were identified using established coding schemes. The findings demonstrated that whereas learners’ formulaic errors outnumbered that of non-formulaic ones in their writings, all three teachers provided WCF more often to address learners’ non-formulaic errors. Given formulaic language use is an indicator of writing quality and is essential to fluent, accurate, and communicative language use, this learner corpus study calls for a more balanced WCF treatment of formulaic vs. non-formulaic constructions in L2 writing. The higher proportion of learners’ errors with formulaic constructions as compared to non-formulaic ones suggests that formulaic language poses challenges to even advanced adult learners. Considering the effective role of WCF in L2 development, this study advocates for considering formulaic constructions as important linguistic targets among other targets for successful L2 learning. Given that teachers are principal decision-makers in language classes, the findings of this study suggest that teacher training programs raise in-service and pre-service teachers’ awareness of formulaic aspects of language, driven by the idiomaticity of language.
Lightning Talk Session I: 11:00 – 11:30 a.m.

The power of light: photonic sintering of ceramics applied to additive manufacturing
Nicolas Somers*, Alejandro Monton, Mark D. Losego

Additive Manufacturing (AM) of ceramics is a timely topic because it allows to produce functional ceramic parts with geometrical complexity that have utility in fields including electronics, medicine, aerospace, and sustainable energy. Currently, AM is achieved most commonly through multistep "indirect" processes. Indirect processes require two or more supplementary steps, such as pyrolysis (debinding) and sintering, to transform the green ceramic body into a final product with desired geometry and properties. Currently, only powder bed fusion and direct energy deposition allow single-step fabrication of ceramic parts without supplementary steps. Recently, photonic sintering of ceramics has been studied using ultrarapid heating with intense light. Xenon Flash lamps can produce intense, ultrashort light pulses (0.1–10 ms) over a broad spectral band (200–1000 nm) with the potential to supply extremely fast heating rates. Various researchers have investigated this photonic technology to sinter ceramic thin films and ceramic bulk samples opening a new route to scalable, fast, efficient and versatile sintering. Here we investigate whether photonic sintering of ceramics can be used to develop a single-step AM process. The idea is to deposit thin ceramic layers by spraying, aerosol jet printing, or material extrusion and then sinter them by flash lamp annealing prior to deposition of the subsequent layer. These steps can be repeated layer by layer to produce a ceramic 3D part without the need of a post-treatment. Powder modifications (coatings/grafting) and additives that could allow a single step AM of ceramic parts are then studied to reach this objective.

Software abstractions for scalable multi-disciplinary inverse problems
Mathias Louboutin*, Thomas Grady, Ziyi (Francis) Yin, and Felix J. Herrmann

With the emergence of physics-based machine learning and cross-discipline applications, new software paradigms are required to research and develop new ideas. To answer these needs, we introduce a software framework building on domain-specific languages and software abstractions that enable the development of solutions for modern problems such as the monitoring of carbon sequestration via seismic methods that require the integration of fluid flow models and their learned surrogates, empirical physical relationships, and wave-equation based inversion algorithms.

I will present the design principles and implementation of our software framework that allows the easy integration and combination of the different building blocks. The usability and application range will be illustrated on various examples including seismic monitoring of carbon storage with a learned prior and ultrasound wave-equation based medical imaging.
Research Talk Session II: 12:30 – 1:25 p.m.

It Takes Two to Make It Right: How Nurses’ Response to Sepsis Alerts Impacts Physicians’ Process Compliance
Zahra Mobini*, Mehmet Ayvaci, Ozalp Ozer

Standard processes have led to improved operational performance in different sectors, including healthcare. Despite the demonstrated benefits of standards, a wide gap remains between what standards suggest and what typically occurs in practice. Automated alert systems can facilitate compliance with standards by identifying situations in which standards apply and prompting workers to act in accordance with those standards. In this study, we focus on sepsis, a life-threatening health condition, for which timely performance of standard care actions—i.e., compliance—is critical, and alert systems are employed to ensure such compliance. We empirically examine how a clinical team, consisting of the two roles of nurse and physician, provides care in compliance with evidence-based standards using a sepsis alert system. In particular, we study whether and when nurses’ timely response to sepsis alerts (i.e., acknowledging the alert and notifying physicians within a designated time frame) impacts physicians’ compliance with sepsis care standards (i.e., performing diagnostic or treatment actions within a designated time frame). Using data from a large hospital system in the U.S. with a sepsis alert implementation, we find that nurses’ timely response has a positive spillover effect on physicians’ compliance with care standards, and this effect is more pronounced for sepsis patients. Our analysis also suggests that nurses’ complementary role in physicians’ decision-making becomes stronger as workload increases and weaker as the number of false alerts increases. In contrast to the traditional view of nurses as subordinates primarily following physicians’ orders, our findings underscore nurses’ key role in improving physicians’ decision-making, supporting recent efforts to empower nurses in hospital operations. Our results also emphasize the necessity of taking into account inter-professional complementarities as well as nuances of workload and technology performance when designing workflows and allocating tasks to ensure quality care.
Research Talk Session II: 12:30 – 1:25 p.m. (continued)

Biomimetic camouflage soft robot
Hyeonseok Kim

These days, demand for artificial camouflage technology is notably increasing for military purposes as well as soft robots, and electronic skin. There have been a lot of significant advances in camouflage technology from the understanding of camouflage in nature to advanced biomimetic camouflage technology. One of the representative animals in camouflage is the chameleon. A lot of researchers have been trying to mimic this color-changing ability match to the background rapidly. There were a lot of tries, but there was no perfect camouflage.

Here is a biomimetic camouflage soft robot with instantaneous crypsis ability. It has a very thin, flexible, color-changeable skin which can be attached to the curvilinear surface conformally, and there is a small color sensing system to recognize its background and control skin color.

By integrating a thermochromic liquid crystal layer with the vertically stacked, patterned silver nanowire heaters in a multilayer structure, versatile artificial camouflage skin with excellent coloration features and various patterns ability could be developed. The temperature of each nanowire layer could be precisely adjusted by utilizing the temperature-dependent resistance of the silver nanowire network as the process variable of the active control system. Combined with the active control system and sensing units, the complete device chameleon model successfully retrieves the local background color and matches its surface color instantaneously with natural transition characteristics to be a competent option for a next-generation artificial camouflage.

This novel technology has great potential that can be applied not only for military purposes but also for soft robots, soft electronics, architectural applications, the fashion field, and so on.
Lightning Talk Session II: 1:30 – 2:00 p.m.

On the Direct Relevance of Motivations to Permissibility Assessments
Sherri Lynn Conklin

I sketch a descriptive model of MORAL PERMISSIBILITY (what one may do morally) and MORAL-WORTHINESS (praiseworthiness or blameworthiness) as structurally similar but nonetheless different moral assessments. This model, which relies on set theory for its framing, assumes that moral permissibility and moral-worthiness are a pair of different-but-similar HYBRID assessments – assessments appealing to the agent-independent facts about the action (ACT-FEATURES) as well as the agent-dependent facts about the motivations for which the agent acted (MOTIVATIONS-IN-ACTING). On this view, moral permissibility is a hybrid ACT-ASSESSMENT (the object of which is an action), while moral-worthiness is a hybrid AGENT-ASSESSMENT (the subject of which is an agent). Yet, an agent’s motivations-in-acting are relevant to permissibility assessments in the exact same way that act-features are relevant to an agent’s moral-worthiness, and evidence for this enantiomorph relationship, between the underlying structures of permissibility and moral-worthiness, is observable in a pair of well-discussed philosophical puzzles. The proposed model supports a view that contrasts with another, more common, view, according to which motivations-in-acting are never directly relevant to permissibility assessments. Proponents of such views, called DEEDS THEORISTS, hold that only the act-features determine some action’s permissibility. Therefore, moral permissibility, on such views, is not a hybrid moral assessment. Deeds theorists think the agent’s motivations-in-acting are only ever directly relevant to a different assessment (i.e., moral-worthiness). Some worry that we are confusing the moral categories and actually assessing moral-worthiness when we appeal to motivations-in-for permissibility assessments. These worries pressure theorists to develop independent accounts of each assessment type, but I take the opposite approach and identify their underlying structural similarities without eliding them. Importantly, my account preserves the spirit of a deed’s theory in that only act-features render actions permissible, but I argue that this is possible even when an agent’s motivations-in-acting are nonetheless directly relevant to permissibility assessments.
Lightning Talk Session II: 1:30 – 2:00 p.m. (continued)

C&C On-Demand: An Empirical Study of Web Application Abuse for Malware Command and Control
Mingxuan Yao, Jonathon Fuller, Ranjita Pai Kasturi, Saumya Agarwal, Amit Kumar Sikder*, Brendan Saltaformaggio

Web applications/apps provide a wide range of utilities, including content delivery (AWS), data storage (Google Drive), and social networking (Twitter). These utilities also incentivize malware authors to integrate these well-known web apps into malware. Web app integration makes the malware stealthier as the produced traffic now masqueraded as benign along with ubiquitous usage by benign users. Stopping this abuse requires technical and policy solutions from Incident Responders (IRs) and Web App Providers (WAPs). However, such collaboration has not happened to date, and little research has been done to prove that WAE malware are prevalent enough to warrant such an investment.

To provide a clear view of web app adoption, we built MARCEA, an automated concolic analysis pipeline, to perform a retroactive study of WAE malware. Given a malware binary, MARCEA identifies web app abuse vectors and partitions them based on the malware’s web app identities (e.g., accounts, username) and assets (files, posts). Using these, MARCEA performs session reconstruction to drive engagement data harvesting from the abused web apps further revealing the activeness of WAE malware. MARCEA also gives IRs an automated attribution of WAE, which empowers rapid collaboration with WAPs toward counteraction.

By deploying MARCEA on 2000 malware from 193 families (spanning 15 years), we detected 487 malware in 72 malware families abusing 30 web apps. Our study also reveals that WAE malware has an average of 502 days before detection. Even after detection, the attackers update assets for an average of 84 days due to inadequate response. By harvesting 29 directly abused identities and assets, MARCEA uncovered 5,844,144 malware-engaged data points. The engagement data MARCEA harvested provides IRs and the WAPs investigation entry points to prevent possible abuse. To test effectiveness, we used MARCEA to collaborate with the WAPs to take down 70% of active WAE malware.
Lightning Talk Session II: 1:30 – 2:00 p.m. (continued)

Sonic Rhetorics in the Technical and Professional Communications Classroom
David Measel*

Musical Listening is a heuristic grounded in sonic rhetorics that is effective in teaching students in composition and rhetoric to be effective and socially conscious rhetors, in addition to honing their skills in sonic and multimodal rhetorics. This presentation will build on my previous research presented in the article “Musical Listening: Addressing the Rhetoric of Music in Sonic and Multimodal Composition” (The Journal of Multimodal Rhetorics), and it will borrow further from Steven B. Katz and Susanne Langer, also incorporating the multimodal theory of Paul Dan Martin. Musical Listening can be adapted for special emphasis in the technical and professional communications classroom. An application of Musical Listening to the study of technical and professional communications would likely need to depend heavily on the study of genre. Genres are frequently quickly identifiable in technical writing due to highly recognizable document design, for the sake of efficiency. It is in this document design, though not at all exclusively, that we can see (and hear) rhythms at work. How we, teachers and students alike, respond to the rhythms of technical and professional communication is an issue not only of efficiency, but also of ethics. Engaging students with the sonic rhetoric embedded in technical and professional communication with Musical Listening offers opportunities to build skills in both sonic and multimodal rhetorics, while helping students gain a deeper understanding of the stylistic characteristics and affordances of technical and professional genres of writing. Furthermore, students wrestle with powerful ethical questions that make the rhetorical situations we cover in class seem a little more concrete and a little less abstract.