



Improving Bandwidth Efficiencies

BY ELISE TAKEHANA

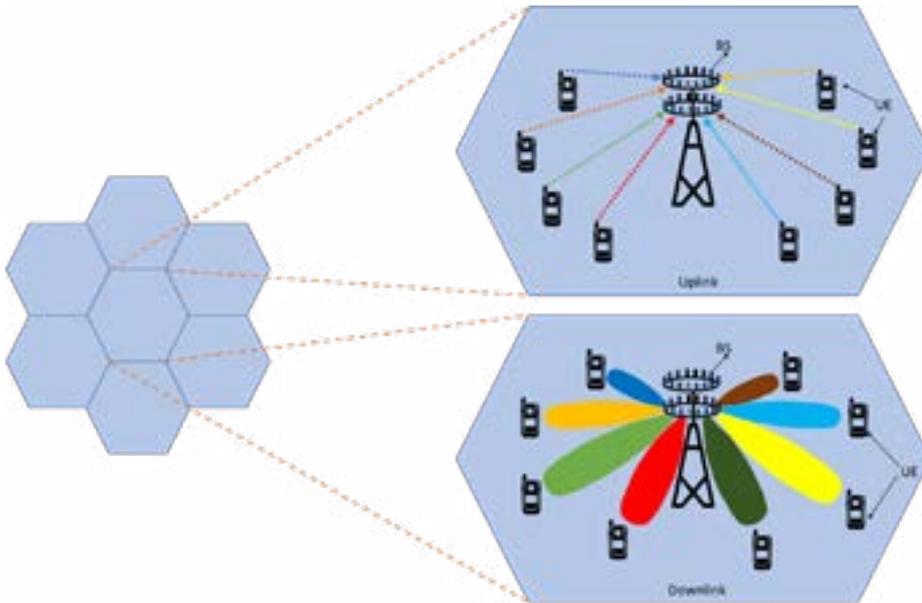
One of Robin Chataut's chief lines of research involves improving the efficiency of 5G and beyond wireless networks, but that calling runs in the family. His uncle is a wireless engineer and it fascinated him as a child. "It's one of the most beautiful things humans have developed, to be able to communicate wirelessly." And after over a year of lockdowns, quarantines, and social distancing, most would be inclined to agree with Chataut.

Despite the miracle of high-speed wireless communication, given the introduction of the Internet of Things and Machine-to-Machine Communication, we are reaching a saturation point with our current bandwidth limitations. It's not possible to simply increase bandwidth since the high frequency signal won't easily penetrate through walls or trees and would require towers every 50 meters. Some researchers are trying to increase the bandwidth through millimeter waves technology and settle some of the arising issues with that solution, but Chataut's work takes a different approach. He's working on Massive MIMO, which increases the efficiency of the existing bandwidth. The necessary efficiency jump is huge. 4G networks have a spectral efficiency of 3 bits/s/Hz, but 5G networks are aiming for a rate of 300 bits/s/Hz. While making that big of a jump in one go is not possible, Chataut's simulations have increased efficiency by 85 bits/s/Hz with 128 antennas.



One of the many challenges of optimizing 5G is minimizing error rates with uplink signal detection. Given the proliferation of smart devices, wireless communication towers receive so many signals simultaneously that separating signals from different users is increasingly difficult. Chataut's recent work presents a combination of three original algorithms for improving uplink signal detection. "We want to have good speed and low error all with less complexity. All of these things are not possible at the same time. That's why we have to do some trade-offs. My algorithms make improvements in terms of error, but it has a similar complexity to that of other algorithms that I have developed."

Chataut's recent co-authored paper "SSOR Preconditioned Gauss-Seidel Detection and Its Hardware Architecture for 5G and beyond Massive MIMO Networks" was especially interesting because he ultimately combined three of his algorithms in his simulation and created a hardware architecture. Because his simulations already look promising, Chataut plans to pursue grant funding to implement real-world testing on a tower that he would need to program. Ultimately, he hopes to include students in this testing.



CAPTION: Uplink and Downlink Massive MIMO System

Although Chataut's focus is on improving efficiency on our existing bandwidth, he is also working with collaborators at the University of North Texas who are using millimeter waves to use larger bandwidth. This project aims to improve the overall throughput in smart vehicle communications that use MIMO technology. While it is unclear now if millimeter waves of Massive MIMO will dominate, some companies like T Mobile and AT&T are "combining both of them, using slightly larger frequency while trying to make them more efficient." Massive MIMO introduces its own complications, like the need for more antennae in our devices and towers, hundreds more per tower. Because so many antennae will be needed, they need to require low power.

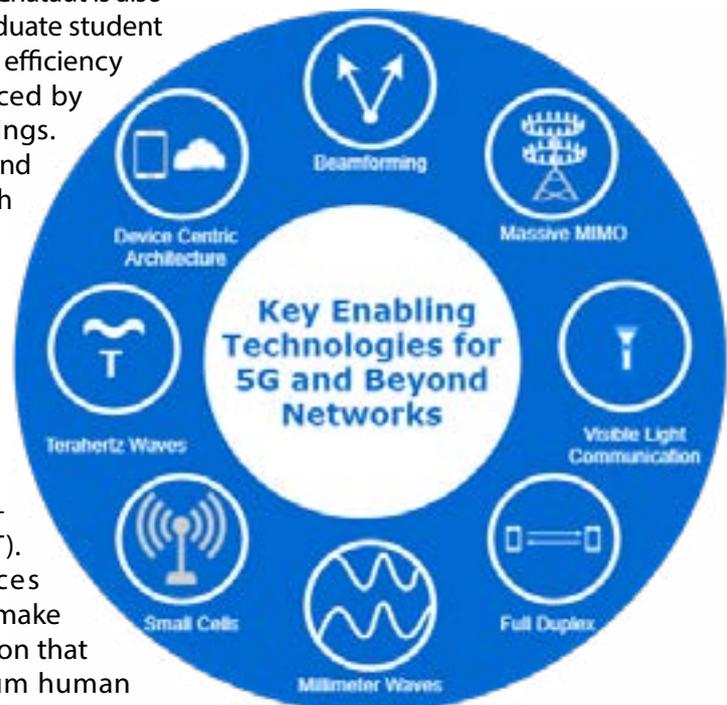
While the impact of our technology usage is not as present in the mind when we think of sustainability, "its effect will be seen in 50-100 years from now. Pulling from or saving to the cloud, definitely wastes energy. Cloud computing takes a lot of power." While power consumption is not

a huge technological concern now, its effects could well be an environmental concern down the line. Chataut and his University of Texas collaborators have already published two articles from their findings and will have more data to share by the end of the year.

Beyond his work in wireless network efficiency, Chataut is also working with a graduate student to explore channel efficiency problems introduced by the Internet of Things. The two will try to find solutions to one such problem in the next academic year. That work might involve further efforts on efficiency algorithms or it could move towards exploring artificial intelligence in IoT (AIoT). With AIoT, devices can analyze data, make decisions, and act on that data with minimum human intervention. Together, AI and IoT are pushing boundaries of intelligent learning and will lead

us into a more connected future. AIoT improves operational efficiency by making the useful data and actions readily available with minimum human intervention. It also reduces the failure and unplanned downtime by identifying the faulty parameters and adjusting them on the fly to prevent failures, and decreases the cost of CPU, memory, and storage.

While wireless networks in the past did not reach their efficiency goals – 4G did not achieve its benchmarks before 5G was operational – the speed of technological development remains shocking. Chataut's algorithms make wireless uplink connections over 28 times more efficient, but not too long ago his home country of Nepal rationed electricity access to six hours per day. While we are getting faster technologies and more reliable connectivity by the year, where those gains might lead us remains unknown. Surely unintended outcomes and novel challenges abound.



Internal Funding at Fitchburg State University

MSCA Professional Development Fund (\$25k)

This fund has three annual deadlines in November, February, and March to support work faculty will do during the Spring, Summer, and Fall semesters respectively. The MSCA Professional Development committee—which includes three faculty members and two administrators—reviews applications. Proposals must address at least one of the below (abbreviated) objectives:

- To improve teaching and student advising and to relate those to a changing curriculum
- To develop new teaching skills and an appropriate facility in the use of media, teaching aids and other supportive techniques
- To improve student advising techniques and the faculty member’s command of relevant bodies of knowledge in this area

- To increase the faculty member’s command of the body of knowledge that constitutes his/her own discipline
- Where appropriate, to enable a faculty member to develop a command over a body of knowledge in a related discipline
- To improve a librarian’s professional skills and techniques and to relate those to a changing curriculum and to develop new professional skills and techniques to the same end
- To provide retraining to members of the bargaining unit who have been or may be given notice of retirement.

PRO TIP: Be very clear and specific about how your budget will be spent.

Special Projects (\$33k+)

Special Projects grants from the Provost’s Office support faculty research projects through majors grants (up to \$2500 each), mini grants (up to \$1500 each), course releases, and student research assistants. A portion of the funding supports anti-racism research or campus efforts. Faculty submit applications in April. The Center for Faculty Scholarship’s Advisory Committee reviews them.

PRO TIP: Clearly explain the benefit of your research without disciplinary jargon and provide details on your budget items.

Deans’ Anti-Racism Fund

The Dean’s Anti-Racism Fund supports campus and community initiatives aimed at ending systemic and institutional racism. Applications are reviewed by the Deans in late October and again every 30 days until all funds are expended. The Google Form application is available at <https://rb.gy/amehj0>.

For more information on this funding source and others on this page, see <https://rb.gy/lsoicq>.

Center Funding

- The Center for Faculty Scholarship funds two student researchers working with a faculty member on a research project. Students complete these applications, due mid-December.
- The Center for Teaching and Learning accepts applications for teaching materials, training sessions, pedagogical conferences or discussion groups on a rolling basis. More to come at <https://rb.gy/wjrcxa>.
- The Center for Italian Culture (CIC) funds projects with co-curricular programming on Italy or Italian culture.

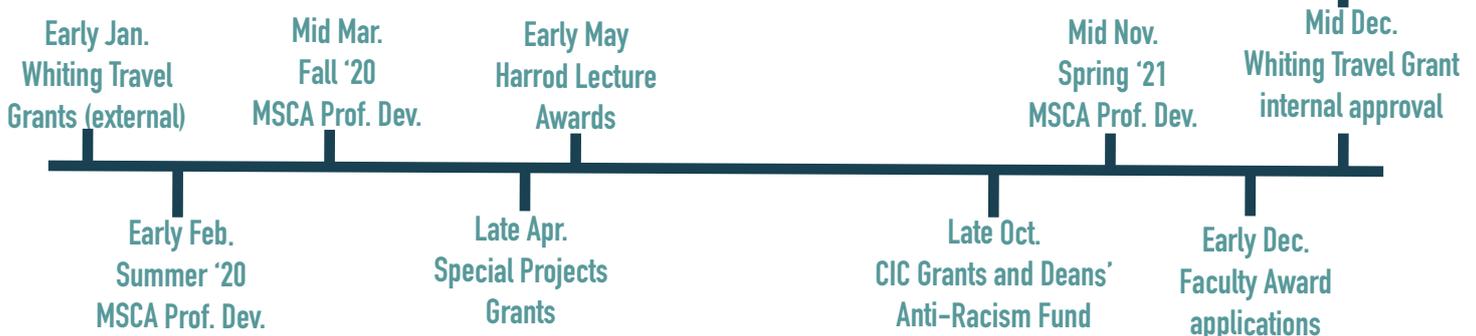
Faculty Awards

- Academic Affairs offers awards for Research and Scholarship, Service, Contributions to Graduate Programs, and Excellence in Teaching. Winners are honored at the May Faculty Symposium and receive a monetary award. More information see <https://rb.gy/qulute>.
 - The annual Harrod lecture features a faculty member whose paper was selected by a committee of tenured peers. Winners receive a monetary prize and deliver a lecture.
- PRO TIP:** Many successful application are actually unpublished full articles that are heavily referenced.

Whiting Travel Grant

While technically an external funding source, the Marion and Jasper Whiting Foundation has granted travel funding to many of our faculty in support of their research. Three of our colleagues — DeMisty Bellinger-Delfeld, Chris Cratsley, and Kisha Tracy — share their experiences and advice for strengthening your application, at <https://rb.gy/bsddxs>.

Internal Grants Timeline



The Challenges of Connecting Communities

BY ELISE TAKEHANA

Mark Williams took a circuitous route to academia, but one always led by the call to help the vulnerable. He began his professional life as an ordained United Methodist pastor, but openly gay people cannot serve as clergy. "I lived with that for a little while because I felt called and passionate, but after about five years, it didn't feel like it had a lot of integrity to continue, so I came out publicly to the church. Ultimately, I maintained my ordination, but it was increasingly a distraction from being able to do what I enjoyed doing." Since serving as clergy did not seem the right fit, Williams found another profession where he could help those in need and discovered social work. While he initially thought he would be working with children, an internship in grief counseling made Williams "fall in love with older adults." While counseling, he came to love the teaching elements of his work and wanted to do more of it, so, alas, he has found his third profession in the professoriate.

While Williams began his doctoral studies focused on gerontology more generally, he found excellent support from experts in his program to explore overlaps in his interest in older populations and the LGBT community. "There is already a lack of a body of research on many aspects of the

LGBT population. If we took out every researcher who themselves are LGBT, it would be a hugely neglected field of study. Under President Bush, there was an embargo against nationally-funded research on LGBT populations in NIH, so it is not by accident that it is an understudied population." During his doctoral studies, Williams got to work on the first NIH-funded study on the LGBT older adult communities in 2009, which became the first national sample of that LGBT older adults.

That dissertation work essentially searched out if the health benefits of marriage previously identified for heterosexual individuals translates to the LGBT community. "There were some states like Massachusetts that had legalized marriage, and had for a while. A lot of the states that we were collecting data in had not. We compared mental health and physical health outcomes for those who identified as single and unpartnered, compared them to those who were partnered but not married, and then compared those to folks who are married." Ultimately, he found that the gains of marriage exist for LGBT individuals. "The more we are connected, the less likely we are to engage in risky behaviors. We are more likely to realize that if 'I go to the doctor, it's not just my health, but it's

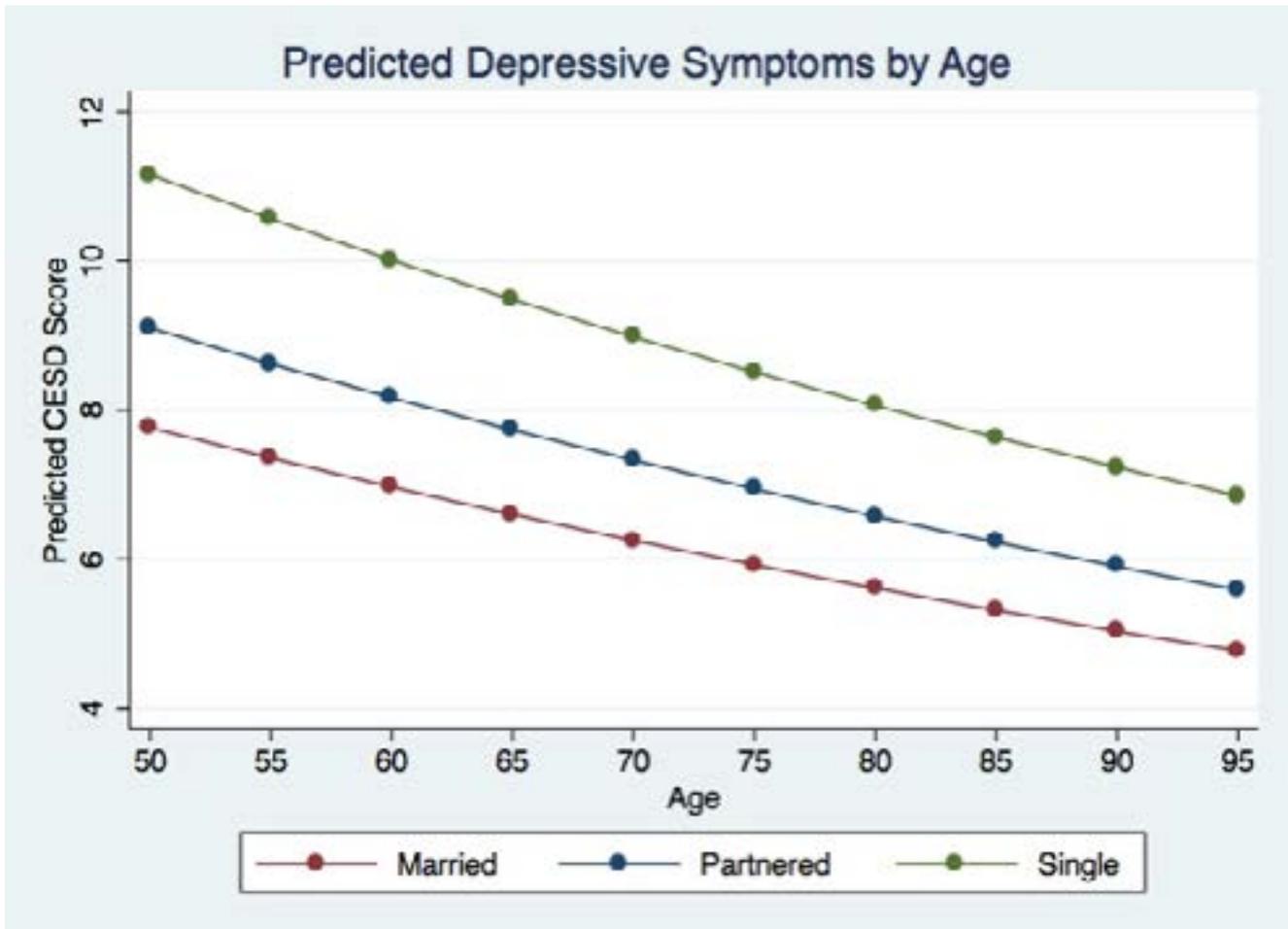
people who depend on me that benefit.' The more socially recognized those relationships are, the more they carry this sense of being integrated."

Currently, Williams is analyzing data from a community strengths and needs assessment of 50-year-old-plus LGBT identified individuals he conducted in Milwaukee. A Community-University Partnership Grant through the university system in Wisconsin funded the research to support an LGBT community center looking to better understand its community before revisiting its programming. He collected 250 surveys about LGBT elders' lives, stresses, resources, and perceptions of community to study the social factors shaping the health and well-being of older LGBT adults. The study also included focus groups.

Of particular interest in the early stages of data analysis has been how LGBT communities are integrated into larger communities. "One thing [LGBT elders] raised as a concern was feeling isolated from younger LGBT folks, and particularly in Milwaukee, there was a perception that white LGBT communities and black, but also Latino LGBT communities, just did not connect. LGBT elders in the focus groups were feeling increasingly isolated as they age because of this splintering."

This sense of isolation from younger populations existed for men and women in the group. While some of this might be attributed to false stereotypes of the predatory older gay man or internalized homophobia, other factors are at play. Even the language of identity used across generations





CAPTION: This figure from Williams' article in the *Journal of Community Psychology*, (Same-Sex Partnerships and the Health of Older Adults, 2014) demonstrates the correlations between symptoms of depression and age for lesbian, gay, and bisexual adults 50-years-old and older, relative to their partnership status.

feels in conflict. "The older adults would say, for example, that the word queer is really off-putting for them. This was an insult that they would be threatened with when they were young. Oftentimes, there would be violence that would follow the use of the word queer. These days, there are a lot of young folks who identify themselves as queer rather than identifying as, for example, gay or lesbian. The different language itself is seen as sort of a barrier to being able to identify that we're part of the same community."

When it comes to acting on Williams' findings of a generational divide, older adults are eager to connect with younger groups, but

with younger folks, "there's a real resistance to building bridges and making connections. They resist that for a lot of reasons, but I think there is an arrogance of youth that says 'I don't have something to learn.' I don't hear that from older adults — this sense of 'I'm only here to give information.' There's a lot of 'I'm missing out on things I want to learn from younger folks.' From the younger generation, there is a lot of resistance."

Williams is also interested in transitional periods in adulthood. For example, elders "may be out in their local community where they have lived independently, but then they need to go into an assisted living facility, and they

are realistically gauging 'Is it safe for me to be out?'" Similar concerns arise when families need to make major decisions. When LGBT elders have been estranged from their families as a result of being out, family decision-making gets complicated.

In the future, Williams would like to get better connected with the LGBT community in Central Massachusetts so he can do similar work to their benefit. There do not seem to be many community centers or supports for the LGBT community in the area. "I know the community exists, but I'm still an outsider trying to identify how to connect."

Marketing in the Age of Big Data

BY ERIC BUDD

For Dr. Yang Liu, a love for shopping brought her to her academic and research interest in the science of marketing. Her research interests cover the gamut from the luxury industry, hospitality and tourism, digital marketing, social media, consumer behavior, marketing strategy, and international marketing. Marketing is constantly changing, and Dr. Liu's research focuses on those changes, and the opportunities as well as challenges they pose. Increasing globalization has opened up new markets for marketing. For example, China is an emerging market with millions of new consumers. With the rise of China and economic growth in other emerging markets, marketing today is truly global.

The globalization of marketing brings with it a number of exciting opportunities for businesses. Data is globalized, and the rise of big data lets companies be more efficient in their marketing. According to Dr. Liu, "Big data enables companies to reach their target consumers directly and save millions of costs they were wasting on the people who would not purchase their goods or services no matter how hard they try. This is due to their ability to use data to analyze the customer's current situation or needs." Prior to the availability of big data, companies had to rely on surveys to understand their market, which is a very labor-intensive and time-consuming process.

Big data not only enables the companies to find their target consumers, but also helps those

consumers find the products and services they need. For example, a pregnant woman needs lots of items and help as she prepares to give birth, so she would benefit from having targeted advertisements and coupons. Big data is thus more efficient and convenient both for the companies and for their targeted market.

However, big data also brings with it some serious concerns. Data security is an issue that goes hand in hand with concerns over data privacy. In a world where one's data is available worldwide, how do we ensure it doesn't fall into the wrong hands, and how can we protect people's right to privacy? Dr. Liu is concerned about who owns the data--- the company or the consumer? Companies collect data from their consumers (with or without their permission), so does that mean the companies now own that data, and thus can do with it as they please? Should they be able to sell a person's data to another company?

While the ability of companies to target consumers thanks to the availability of big data is very efficient and convenient, it also raises some big concerns as well. Data could be used to trap or manipulate consumers.- For example, consumers could be manipulated into

purchasing something that they do not need.

Consumers can also be charged a higher price just because they are (or are considered to be) richer than others. This is an example of price discrimination, which is another area of concern when it comes to big data. Price discrimination occurs when different consumers are charged different prices for the same good. According to Dr. Liu, "Based on data analytics, consumers could be charged a higher price because based on their data the company determined they could, or would, pay a higher price."

As the world becomes more and more globalized, so too does our data. While globalization brings many benefits, it also raises some big challenges. For Dr. Liu, this shows the need for greater transparency in data collection. She believes individuals should have the right to access their data, and have greater control over its dissemination. There is also a need for greater regulation on how companies use that data. With greater transparency and regulation, companies and consumers can reap the benefits that come from big data, without worrying about its ramifications.



The Dark Side of Big Data: Personal Privacy, Data Security, and Price Discrimination

by Yang Liu and Connor Greene

ABSTRACT: New information technologies enable big data collection, analysis, and forecasting. Based on big data, firms now have the capability to manipulate consumers, deliver personalized advertisements, and apply price discrimination policies. On the other hand, concerns about personal privacy and data security arise with big data. This chapter discusses concerns regarding the dark side of big data through observations of results for consumers led by firms sharing and using these data.

The Center for Italian Culture: 20+ Years of Evolving with the University

BY ERIC BUDD

Just over twenty years ago, the Center for Italian Culture (CIC) was established by Fitchburg State College. According to Dr. Daniel Sarefield, the Academic Coordinator of the CIC, its mission is “to encourage the understanding and appreciation of all aspects of Italian language and culture, including ancient and contemporary studies, and the Italian experience in the New World.” Over the years, as Fitchburg State transitioned from being a college into a university, the CIC has evolved as well, in an attempt to increase its integration into the academic life of the University.

From the beginning, the CIC has sought to develop programs that would highlight the Italian language, culture, and rich history. Additionally, it has sought to promote Italian language instruction, not only at Fitchburg State but also in local area schools. The CIC also supports study abroad in Italy such as in our Verona summer program, but also for students wanting to spend an entire semester in Italy. According to Dr. Sarefield, the CIC also works “to collect and preserve the history of the experience of Italian immigrants to Massachusetts, and Central Massachusetts in particular, through the CIC archives which are located in the FSU archives.” Finally, the CIC, through the Amelia V. Gallucci-Cirio Endowment, supports students and faculty who are interested in Italian history, language, and culture.

In fall 2019, the CIC created the position of Academic Coordinator, with Dr. Sarefield the first to hold this alternative assignment. The creation of this position is part

of an intentional effort by the CIC to enhance the academic nature of its programming, and to better integrate the CIC into the academic life of the University and the community. Over the past few years, the CIC has sought to align its own programming and activities with the work that students and faculty are doing in the classroom, as well as with other programs on campus. According to Dr. Sarefield, “the goal is to continue this process and leverage the assets of the CIC in ways that further increase its impact at the University, and also bring the organization and FSU into contact with wider audiences that share our interests and goals.”

This academic year, the CIC has decided to focus on confronting Italian colonialism, such that throughout the year it will be sponsoring a series of programs around that theme. In November the CIC had a screening of the documentary *If Only I Were That Warrior*, with a special Q+A session after the screening with the film’s director and cinematographer. The film focused on the recent controversy in Italy over the establishment of a monument in honor of General Rodolfo Graziani, and the unpunished war crimes committed by Graziani and others

in the name of Italy’s colonial ambitions. In the spring, the CIC is sponsoring a visit by the Ethiopian-American author Maaza Mengiste, who will be discussing her novel *The Shadow King*. The novel is set during Italy’s 1935 invasion of Ethiopia. Several classes have adopted the book for their spring syllabi, and the CIC is planning several book discussions and forums on related topics.

In the future, the CIC would like to host scholarly conferences and symposia related to its mission, such as conferences on Italian-American immigration or the history of Verona during Roman times. With these scholarly gatherings, the CIC hopes to be able to generate the creation of new knowledge, as well as new opportunities to appreciate the Italian language, culture, and experience. As the CIC continue to evolve, the study of Italian history, language, and culture will be at the forefront of intellectual life on campus and in the surrounding communities.



CAPTION: Sarefield in Verona doing a site visit with students of a Roman domus under the Banco Popolare di Verona in Piazza Mogara.

Events

Please send details of events related to faculty research or intellectual life to etakehan@fitchburgstate.edu for inclusion on the Center for Faculty Scholarship's calendar and newsletter.

12 06 21

12:30 CTL

Prof. Amanda Suzzi shares her talk "How Do You Teach Environmental Justice to High School Students?" as part of the Faculty Speaker Series.

12 07 21

3:30 Hammond Main Lounge

A reading group will meet to discuss Maaza Mengiste's novel, *The Shadow King*. This event is sponsored by the Center for Italian Culture.

12 17 21

DEADLINE

CFS Faculty-Student Research funding applications due. Students should submit applications to Eric Budd at ebudd@fitchburgstate.edu or Elise Takehana at etakehan@fitchburgstate.edu.

01 18 22

3:30 Hammond Main Lounge

A reading group will meet to discuss Maaza Mengiste's novel, *The Shadow King*. This event is sponsored by the Center for Italian Culture.

01 25 22

3:30 Ellis White

Professor Roy Domenico, chair of the Department of History at the University of Scranton, will speak on the history of fascism in Italy.

02 03 22

DEADLINE

MSCA Professional Development funding deadline for Fall 2022 projects are due. Submit applications to Deresa Webb at dwebb5@fitchburgstate.edu.

02 07 22

12:30 CTL

Prof. Laura Garofoli shares her talk "Leveraging an Apprenticeship Model to Improve Reading, Information Literacy, and Learning" as part of the Faculty Speaker Series.

02 15 22

3:30 Hammond Main Lounge

Keynote with Maaza Mengiste, author of *The Shadow King*, which was shortlisted for the Booker Prize and named one of *The Guardian's* Ten Best Contemporary African Books.

03 07 22

12:30 CTL

Prof. Eric Budd shares his talk "Reimagining the Post Conflict State" as part of the Faculty Speaker Series.

03 15 22

DEADLINE

MSCA Professional Development funding deadline for Summer 2022 projects are due. Submit applications to Deresa Webb at dwebb5@fitchburgstate.edu.

03 30 22

3:30 TBA

Dr. Philip Day of UMASS Medical School will speak on ethical issue surrounding the use of data in medical care and decision making. A reception will follow the

04 04 22

12:30 CTL

Prof. Ben Railton shares his talk "Two Sandlots: Baseball, Bigotry, and the Battle for America" as part of the Faculty Speaker Series.

04 27 22

3:30 TBA

The CFS's Third Annual Faculty Colloquium features Dennis Awasabisah, Michael Hove, Ben Levy, and Tara Mariolis, who will present their work on "Using Data to Address the Health Challenges of the Future." Reception to follow.

05 02 22

12:30 CTL

Prof. Eric Williams shares his talk "Designing Disease-Oriented Student Research Projects" as part of the Faculty Speaker Series.

05 17 22

8:30 Faculty Symposium

Faculty present their research with 10-minute talks in the morning. Faculty Awards are announced following a lunch celebrating our colleagues' great work.



Research Live

The Center for Faculty Scholarship

Co-Coordinators: Eric Budd and Elise Takehana

If you are interested in having your work featured in *Research Live*, contact Elise Takehana at etakehan@fitchburgstate.edu

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