

CONNECTIVITY TIMES

No. 4, 2023



June 2022 - April 2023

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Outreach

How do you communicate your research to a broad audience? And how do you do that when your audience is a group of 11-years old? How do you prepare



for their questions? That's what we learned at our outreach event at Durham, together with IAPETUS students. Hear about this training and how Rachel and Julia experienced it - the ups and downs and if they would recommend it?

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Meetings



Our annual meetings for 2022 and 2023 took place in Bremen and London—with a lot of interesting and inspiring talks, presentations from ESRs and work package leaders as well as relaxing social events.

And of course, our ESRs participated in two amazing workshops that accompanied the meetings. Read all about them in this newsletter!

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Reports

Our project coordinator Jenny King tells us how she feels being part of i-CONN, running its administration and which - sometimes unexpected and surprising - tasks were waiting for her over the last years.

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Secondments

Learn all about how our ESRs Venetia, Yanhua, Mario and Deborah experienced their secondments, the new insights they got and how secondments are challenging and very much rewarding and valuable at the same time.

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Summer in Bremen

Deborah Priß

Our annual meeting in 2022 took place at Jacobs University (recently renamed Constructor University) in Bremen. The event with the theme “A unified framework of methods and approaches in connectivity science” brought together most of the members of the i-CONN project to present and discuss the developments of the last year.

The meeting kicked off with two invited speakers, first Annick Lesne who talked about “Contact networks, chromosomal space and the notion of digital and analog control in Biology and Medicine” followed by Hannah Zoller giving us insights into her PhD project about “Computing the adaptive cycle”. What a great and diverse start to our meeting!

The work package leaders then took the stage to provide updates on their respective work packages and discuss how they are contributing to the broader project goals. They did – as usual! – an amazing job of pulling everything together and providing the thread that connects all our projects. Gathering the information about our projects, our methods, our theories and tools is not an easy task and sometimes requires a certain amount of creativity (especially when it comes to getting contributions from everyo-

i-CONN Annual Meeting

Bremen, June 20-22 2022



ne). The presentations were followed by interactive discussions, providing an opportunity for everyone to exchange ideas and ask questions.

Reka Albert concluded the first day with her talk on the topic “Driving a complex system into one of its attractors using the connectivity and logic patterns of its interactions” which illustrated how much we can learn from abstract models about the functioning of complex systems and the hidden patterns behind them. We closed the day with a brilliant barbeque on campus, with bright sunshine, delicious food and engaging conversations.

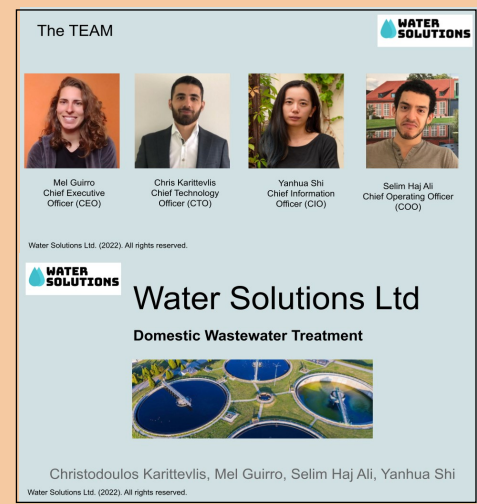
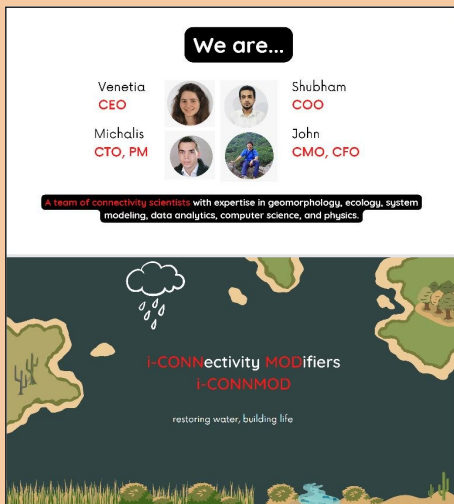
The next day started with Delio Mugnolo who gave us an overview about “Connectivity and network analysis: mathematical tools for clustering, ranking, and more” – something incredibly important and relevant for all of us. The rest of the day was dedicated to us ESRs. As usual, we had the chance to present the progress we made on our projects and get some invaluable feedback from the i-CONN members. This is always a great way to get a new perspective on our work, maybe rethink certain parts or include additional ideas.

Our last day of the meeting focused on i-CONN as a transdisciplinary network with Louise explaining how transdisciplinarity is

understood and put into practice and leading a panel debate about the relevance of secondments in this context. We ESRs also had the opportunity to record a 3-minute talk, a way to communicate our research to the broader public in a short and accessible format. The results are available on our website <https://iconn.network/vlogs/> - have a look at the videos, they're brilliant! Our final speakers Stefan Bornholdt and Thilo Gross completed the day with their talks on “Statistical mechanics of brain criticality” and “Causality from correlations and network structure”.

The meeting was not all work, though. In the evenings, we gathered in the University Club to chat and unwind after a long day of presentations and discussions. We also had a chance to explore the beautiful city of Bremen with a guided tour on the Saturday before the meeting, which gave us an opportunity to learn about the city's rich history and culture – including of course the Bremer Stadtmusikanten (town musicians). In case you never heard about it (which would be a shame!) you can read it here <https://www.grimmstories.com/language.php?grimm=027&l=en&r=de> in German or English. By the way, the story seems to have spread far and wide as even Mel knew it from Brazil, although slightly amended. Bremen is a cosmopolitan city after all!





From PhD to Entrepreneur

Turning research into innovative and sustainable business

Chris Karitevlis

Three days before the start of our 3rd Annual Workshop in Bremen, all the ESRs had the opportunity to participate in a three-day workshop with the topic 'i-CONN Innovation, PhD to Entrepreneur'.

The MBA mentor of Durham's University Business school and Director of *The developmentspace.com*, Claire Rose, informed, led, and directed the useful and inspiring workshop. In just three days, thanks to the very informative lectures, knowledge, and guidance of Claire, the ESRs were able to turn their research work into innovative ideas and directly applicable projects for solving real life's problems. Through this workshop, the ESRs gained deep understanding about the different steps one needs to follow to turn an idea into real product or service.

More specifically, during the workshop the ESRs learnt and applied those steps for their ideas. The most important steps are

i-CONN Short Course: Enterprise Skills

Bremen, June 14-17 2022

the identification of the problem, the innovative solution, the value proposition, finding the right team, coming up with a good business model, defining the go-to market strategy and finally the growth plan of the company. Special attention was given on the ESG framework, which stands for Environmental, Social and Governance, and how to apply these non-financial factors in business and create sustainable products or services.

On the third day of the workshop, the 15 ESRs made three teams of five each and put the acquired new knowledge into practice. Each team collaborated and prepared a Pitch Deck for presenting their proposed innovative idea to potential investors and experts in the relevant fields. All the teams had the chance to present their projects to the evaluators and answer questions. The winning team, with their startup company named i-CONNMOD, which stands for 'i-Connectivity Modifiers', have presented a novel and sustainable approach for water restoration thus gaining the interest and attention of the mock investors.





God Save i-CONN!

Interdisciplinarity meets in London

Mario Díaz

London, a melting pot of diverse cultures, ideas, and perspectives, hosted our final i-CONN Annual Workshop from 27th – 29th March 2023. The city, known for its thriving arts and cultural scene, with numerous museums, galleries, theatres, and historical landmarks, stimulated a series of talks, seminars and poster sessions that crystallized almost 3 years of collaboration between all of us.

Each of us, ESRs had to give a presentation about our last results, progress and obstacles in our research endeavours. What started as a group of people being interested in each other's topics and tools has beautifully transformed into a group of friends who admires each other's work and efforts.

When it comes to the seminars, these were diverse as diverse is our humble and wildly interdisciplinary network. The first panel of the workshop ("The Future of Past Networks: Why Networks are Important for Understanding the Past, and Why the Past is Important for Understanding Networks" by Fiona Coward) del-

i-CONN Annual Meeting

London, March 27-29 2023

ved into the intriguing topic of how networks play a crucial role in comprehending the past and how understanding the past can shed light on the dynamics of networks. Fiona highlighted how insights from historical research can provide valuable lessons for managing present networks and predicting future trends. The panellist presented diverse case studies from various fields, such as archaeology, history, and anthropology, showcasing how the analysis of past networks has provided valuable insights into the dynamics of networks and their impact on societies.

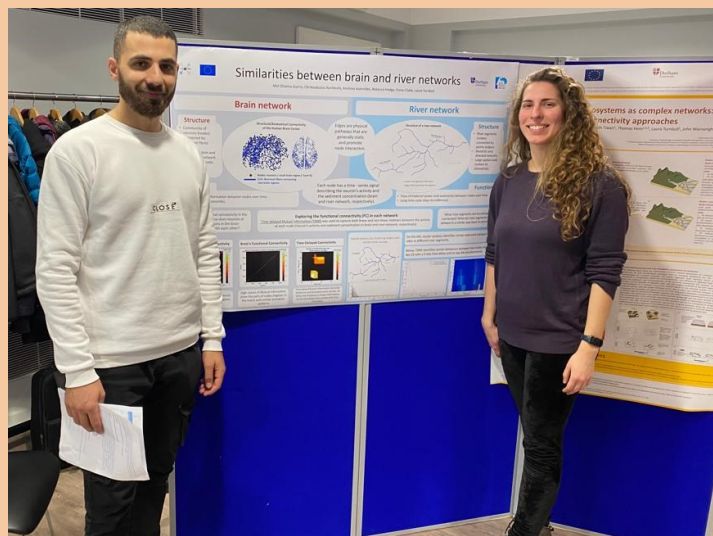
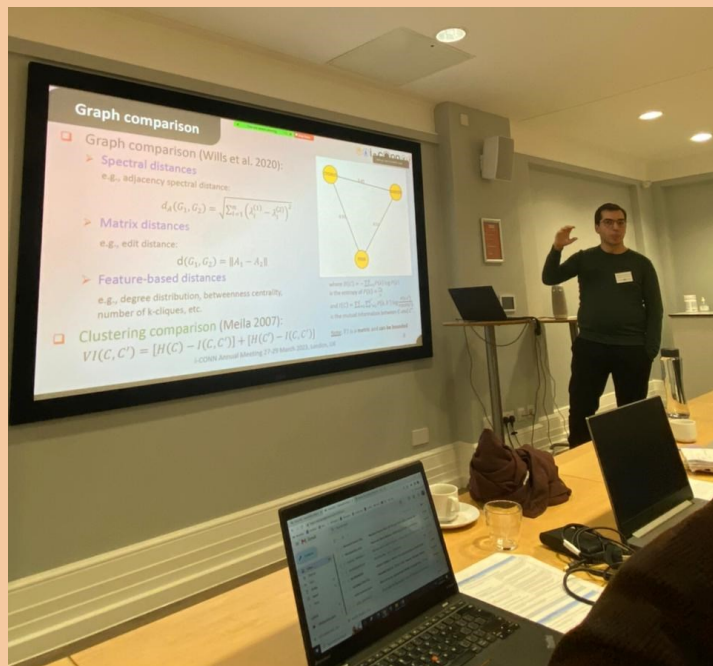
The second panel ("Catchment System Connectivity" by Damian Crilly) highlighted the interconnectedness of catchment systems, exploring how different components of catchment systems, such as rivers, society and governance structures are connected and influence each other. Therefore, it showcased the need for a systemic approach to governance to protect catchment systems in the UK and beyond.

The third panel ("Multi-level Governance and Power in Climate Change Policy Networks" by Monica Di Gregorio) focused on

the complex interplay of governance and power dynamics in climate change policy networks. The panelist presented empirical studies and theoretical frameworks that shed light on the distribution of power and decision-making authority within climate change policy networks. Monica also discussed the ways in which power imbalances can influence policy outcomes and hinder effective climate change mitigation and adaptation strategies.

The fourth panel (“Digraphs are Different: The Importance of Directionality in Complex Systems” by Sam Johnson) delved into the crucial aspect of directionality in complex systems, specifically digraphs, which are graphs with directed edges. Sam discussed how directionality influences the behaviour and dynamics of complex systems and how it can significantly impact our understanding of networks.

In addition to the panel discussions, the meeting featured collaborative and transdisciplinary posters by ESRs, showcasing their research on various interdisciplinary topics related to networks and complex systems. The presentations covered a wide range of topics, including social networks, biological networks, economic networks, and collaborative networks.



Look, I'm on TV!

How to deal with the media

Mario Díaz

Recently, I had the pleasure of attending a communication and media workshop given by Chris Jameson from Inside Edge, a former BBC reporter. The workshop was designed to help us improve our communication skills, particularly in the context of media and journalism. Chris had a wealth of knowledge and experience in the field, and we found the workshop to be extremely valuable.

The workshop began with a discussion of the basics of effective communication. Chris emphasized the importance of clear and concise language, as well as the need to understand your audience. He also discussed the importance of nonverbal communication, such as body language and tone of voice, in conveying meaning and building rapport with others.

One of the key takeaways from the workshop was the importance of preparation in effective communication. But not all preparation! There are a few key things that reign over others,



such as the message you want to come across and strategies to be in control of the conversation. Don't let those sneaky reporters trick you! This was particularly important in the context of media and journalism, where accuracy and credibility are paramount.

Another valuable lesson from the workshop was the importance of storytelling in effective communication. Chris discussed the power of narrative in capturing people's attention

i-CONN Short Course: Dealing with the Media

London, March 30-31 2023



on and creating an emotional connection with your audience. He also provided tips on how to structure a compelling story, such as starting with a strong hook and using vivid language and imagery to bring the story to life.

One of the most interesting parts of the workshop was when we were forced (indeed) to perform a close-to-reality experience either on podcasting, short interviews, panel discussions or being recorded with a camera while answering some questions. This was extremely challenging, but unexpectedly rewarding. There was a nice learning and fun curve over the workshop in which each of us, although through pain and imposed embarrassment, improved and experienced how real communication could unfold with us as protagonists.

Overall, I found the communication and media workshop given by Chris to be an incredibly valuable experience. We gained a greater appreciation for the skills and expertise required to be successful communicators. We came away from the workshop feeling more confident in our ability to communicate effectively, and with a greater appreciation for the power of storytelling in connecting with others.



Curious About the Marie Curie PhD Fellowship?

Research Diary by Mel Guirro

"Are you considering pursuing a PhD and wondering what the experience of a Marie Curie PhD fellowship might be like? I'm a Marie Skłodowska-Curie fellow for almost 3 years now and I can tell you what it feels like. When I talk to other PhD friends I have, I notice that the Marie Curie fellowship is famous for providing a great salary and financial support to do research. But this fellowship offers so much more. "

More: <https://iconn.network/journal/curious-about-the-marie-curie-phd-fellowship/>

How climate change nearly ruined my thesis

Research Diary by Julia Costescu

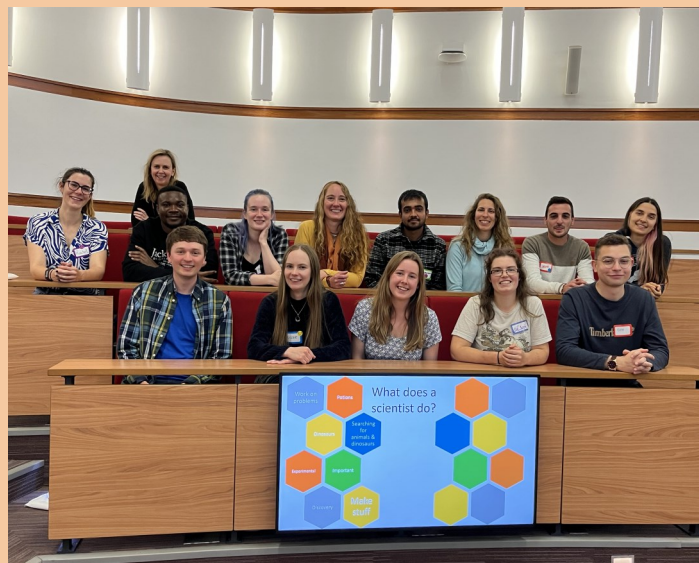
"There aren't many things in life you can take for granted as easily as British rain. In Durham, in Northern England, all of us international students have learned that just because it's clear skies one minute, doesn't mean you should get excited and plan for a stroll in the park, or at least do so armed with a rainjacket, because it will all change within twenty minutes and rain is an inevitability. "

More: <https://iconn.network/journal/climate-change-ruined-my-research-almost/>

Outreach

What is outreach? The goal of Scientific Outreach is to communicate STEM knowledge and techniques to everyone, encourage participation, and inspire younger generations to consider a career in the STEM subjects. This can be through talks/lectures, school visits, science fairs, workshops, or online!

Back in September, i-CONN and IAPETUS2 PhDs joined forces to learn a bit more about this and deliver an outreach event to a local primary school. Rachel Steenson (IAPETUS2) and Julia Costescu (i-CONN) share their experiences with us, how they felt during those three days, what they learnt and how it was challenging for them to communicate their research to a room full of 11-year olds.



Did the course turn out to be as you expected or was it different (and how)?

Rachel: Not quite as I expected! Admittedly, we didn't know much going into the course, other than we would be working with a school group on the wednesday morning. I perhaps naively thought this might be us participating in an event that had been planned by Lorraine and Paula (the Durham outreach team), but WE as a group had to plan and run the morning event!

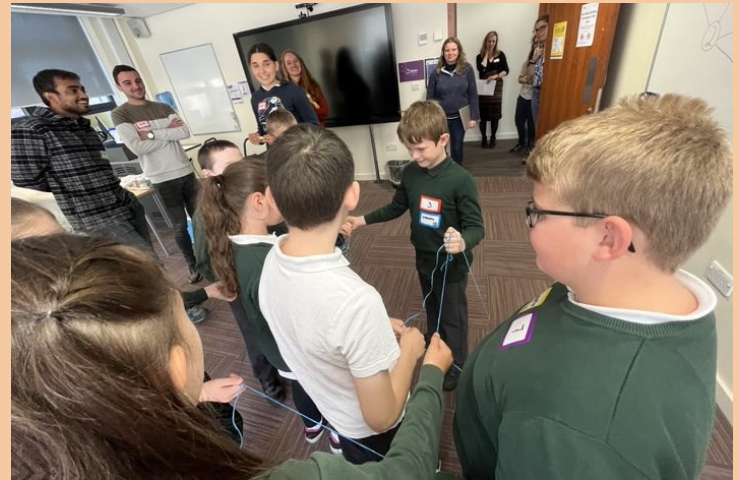
Julia: My experience was similar - somehow I was still expecting the usual setup of passively sitting through lectures and maybe getting some input from the school kids. It was certainly daunting when it finally dawned on me that we would have to not only design but also run the outreach event within the two and a half days. That being said, I was happy that it meant I was spared the nervous anticipation and just had to get on with it as a fun challenge together with my colleagues.

What impressed you most about the kids?

Rachel: How eager they were. They were put in a novel situation, and we were warned that they might be quite shy, but they all threw themselves in headfirst. One of the activities we planned involved the kids asking us all about our research to figure out which set of pictures belonged to us. It could have gone so wrong if the kids didn't want to speak to us as strangers, but they completed the task with such enthusiasm!

Julia: I was impressed that there was no cynicism at all, and they were all genuinely happy to be there. I was expecting at least some of the kids to be uninterested or bored or standoffish since they had no choice but to come along, but to a one, they were all so earnest and open to everything we prepared for them. It was an incredibly positive experience.





What was the most challenging part of putting together and delivering the outreach activity?

Rachel: The timescale! We only had 1.5 days to get to know each other, plan and test a range of engaging activities across 2 broad and very different subjects within science, then do it for real. We're used to deadlines as researchers, but rarely so short for something so out of our comfort zone.

Julia: Actually working through the practicalities of the activities was quite tricky as you would normally need a bit more practice time to see what works or doesn't and tweak accordingly, and in our case some adjustments were even made between subgroups of kids visiting our station.

Would you prefer doing outreach with kids or with adults? Why?

Rachel: I'm not sure. Maybe kids? You have to simplify things and need to be ready for anything to come out of their mouths, but you can massively increase the engagement and fun factor with activities, and I think you'll see more awe and inspiration as an outcome.

Julia: Kids 100%. It can be exhausting but also quite infectious to be around that kind of energy, and it gives you the license to not take yourself so seriously and have fun as well. I'm also a great believer in the power of education to address some of society's greatest challenges, so having even a small part in inspiring the next generations to help tackle these is quite a privilege.

What was especially reassuring for you when working with the kids?

Rachel: If anything went wrong, or we had any questions, Lorraine and Paula were right there. The teachers were also fantastic, helping us where needed, and encouraging the kids throughout the morning.

Julia: There was an actual moment when, after I had apologized for the experiment not going quite right, one of the kids told me that they thought we were doing great - how cute was that! And it totally made my day.



Secondments – interdisciplinarity at its best

Secondments have been a major part of our i-CONN experience and they helped us in diverse ways. Some taught us new methods or software, others let us dive into new theories; some opened our mind to look at our work from a new perspective, others offered us a whole new toolset. But not only the professional part of the secondments had a huge impact on us, the social side was equally important. Getting to know the host ESR and PI better, making new friends and expanding our networks made our secondments even more worthwhile and, hopefully, some of those new connections will outlast the i-CONN project and become valuable connections in the future.

Secondments so far:

-  ESR1 Shubham Tiwari: *AAISCS, BOKU, Jacobs University*
-  ESR2 Venetia Voutsas **European University Cyprus, Durham University**
-  ESR3 Selim Haj Ali: *AAISCS, European University Cyprus, Durham University*
-  ESR4 Harald Waxenecker: *IIASA, Jacobs University, Groningen, European University Cyprus*
-  ESR5 Vinicius Lima: *AAISCS, European University Cyprus*
-  ESR6 Mel Guirro: *University of Vienna, AAISCS*
-  ESR7 Michalis Papadopoulos: **AAISCS, Durham University**
-  ESR8 Sonia Recinos: *European University Cyprus, IIASA*
-  ESR9 Yanhua Shi: *IIASA, Modul, EA, BOKU, European University Cyprus*
-  ESR10 John Perez: **Durham University, IIASA, BOKU**
-  ESR11 Christodoulos Karittevlis: **European University Cyprus, Jacobs University, Durham University**
-  ESR12 Mario Díaz: *IIASA, Jacobs University, EA, European University Cyprus*
-  ESR13 Deborah Priß: *Groningen, IIASA, AAISCS, Jacobs University*
-  ESR14 Marcel Mallow : *Masaryk University, EA*
-  ESR15 Julia Costescu : *EA*

* in person | virtual | partially virtual

Secondments in i-CONN

Venetia Voutsas

The i-CONN network offers us an opportunity that is not so common for a typical PhD student: secondments – a chance to leave our home institution for some weeks or months and temporarily work at a different institution, most likely in a different country, under the supervision of different professors. Unluckily, the COVID pandemic broke out a few months before i-CONN kicked off. Hence, the excitement of travelling to universities across Europe faded momentarily and the travel restrictions transformed many secondments to “shorter online stays” in other places. Nevertheless, the gradual relaxation of the travel regulations gave the chance for mobility within the network.

Having experience of two in-person secondments – one in Cyprus and one in Durham – I could say that they offer a mix of diverse feelings: excitement, frustration, motivation. Travelling across Europe



and escaping from the monotony of PhD work is tempting. Adjusting to a new city and the type of work and communication among people from other universities requires some extra time and effort. Sharing difficulties with other PhDs always helps to overcome obstacles, brainstorming, starting and supporting a common project increase motivation and willingness to investigate and explore new scientific areas. In my both secondments, the hosts were more than supportive, not only with establishing and progressing the common project but also with all the practicalities that come with a temporal stay in a new city.

It is an open secret that collaborations – and secondments are no exception – are usually difficult. They often slow down the completion of a task, they might cause an unproductive diversion, or lead nowhere. But in any case, – especially when they prove to be successful – they can enrich your personality with a significant number of soft skills. As cliché as might sound, if you work with other people you “have to” be flexible; open-minded to follow their way of thinking, assertive enough to

maintain your way of thinking and overall, a good communicator. During secondments, we learn how to make the most of the group members’ strengths to achieve the best outcome. I like a lot the alertness one should exhibit to productively collaborate with people. And the intense collaboration that usually occurs during secondments impels all of us to develop these skills. Furthermore, secondments exhort us to get involved to a large range of projects from different scientific domains. And having this experience in the early stages of our careers allows us to discover interests that, perhaps, we were not aware of and visualize ourselves working on different subjects in the future.

All in all, I would assess positively both of my secondments. The outcome of the secondment in Cyprus was a manuscript with a theoretical focus, whereas due to my secondment in Durham, I developed programming skills for handling real data, which most likely would not have happened if I had not diverged from my core PhD work for a while. In addition to the secondments where I moved to other Universities, we hosted ESRs at our University. In this case, I also worked with real data, specifically with geoarchaeological data. It was a truly pleasant and smooth collaboration, and I enjoyed working in such a different field.

To conclude, one point I believe makes a scientist successful is steadily oscillating between doubting and verifying themselves and their expertise; and networking is an excellent method to develop the required skills to become a better scientist. I consider secondments to fulfil this purpose to a great extent.



Mindblown – how my secondments challenged me

Deborah Priß

A key aspect of our individual PhD projects in i-CONN are secondments, research visits to selected partner universities to collaborate with other ESRs and their supervisors. Secondments offer an opportunity to help us gain insights into the field of our hosts and identify methods, tools and concepts that could be transferred to our own discipline and project. It certainly cannot get any more interdisciplinary!

I could see how a secondment with Christina Prell and Brian Fath would help me understanding social (Christina) and ecological (Brian) network analysis, especially because those concepts were new to me and I had no idea about how to use them for my work. They both helped me a lot with their expertise and

lectures and Christina is now part of my supervisory team to support me with the social networks of my past societies.

But how exactly could spending time with Andreas Ioannides





and learning about neuroscience help me with my archaeological systems? Well, it turns out that the brain and ancient settlement systems are not as different as expected and together with Chris, we developed an algorithm to find potential missing settlements from the fragmented archaeological record we have.

My third secondment with Ronald Pöpl never happened because by the time we could finally arrange an in-person secondment in Vienna, my project aim and ob-

jectives had changed in a way that his expertise was not related to it anymore. This is not uncommon and more than one of us ESRs adjusted their secondments to better fit the needs of our evolving projects. So, instead of spending time in Vienna, I got to enjoy the beauty of Bremen as we decided to do the secondment with Marc-Thorsten Hütt, his background being in physics, mathematics and systems biology. And again – what does his expertise have to do with archaeology? My project involves the development of algorithms to improve the inherently incomplete archaeological data and he and Venetia were a huge help

to design a sensitivity analysis and to evaluate its results.

All in all, those secondments helped me to think outside the box, learn things I thought I would never be able to understand and helped me to progress with my research in unexpected but fascinating ways. And most important – I got to spend some weeks in beautiful Cyprus and in Bremen, which is not too far from my hometown. Sadly, my secondments with Brian and Christina had to be moved online because of the covid restrictions back then. However, I would not want to miss those experiences that forced me out of my comfort zone and into the deeper realms of connectivity!



Filling the Gaps

Research Diary by Deborah Priß

“Needless to say that despite all these exciting new things I did together with Andy and Chris, I also enjoyed Cyprus, said to be the most beautiful island in the world (according to Chris, who arguably is a Cypriot). All that’s left to say is that I wouldn’t mind having another secondment there – to benefit from our neuroscientist’s expertise, of course! ”

More: <https://iconn.network/journal/filling-the-gaps/>

A secondment experience where social science and ecology are brought together!

Yanhua Shi

If you look into the secondments planned for each ESR, i-CONN is very much about interdisciplinary collaborations. In my case, primarily working in the field of new institutional economics, I have quite diverse secondment arrangements with partners from systems biology, political ecology, astrophysics, computer science, and ecology. In this article, I’d like to talk about one of these secondments, with BOKU, where social science and ecology are brought together to understand how institutional approaches can be combined with ecology to uncover the governance challenges of the 48 km stretch of the Danube east of Vienna.

Before the secondment officially began, we attended the i-CONN advanced course in Vienna, where the host ESR Sonia introduced her work on the assessment of the side-arm restoration measures in the area. We did a field trip looking into how these measures have been implemented and their impacts on the hydrological and habitat connectivity.



Looking back, the experience and learning during the advanced course surely provided a good basis for the secondment later on. The on-site and in-person exchange helped me a lot to understand how different river engineering techniques could impact the river in many different ways. As an institutional analyst, my first instinct was to ask what are the rules guiding these actions, who are the involved actors in making the rules and decisions to guide the daily operational activities, are these processes fair and just, have the rules and activities changed over time and how does it respond to the biophysical and ecological conditions?



Bearing these questions in mind, Thomas Hein, the host supervisor in BOKU, introduced us to the responsible staff from Viadonau, the company affiliated to the Ministry of Transportation in Austria and in charge of the implemented measures, as well as facilitating key interest groups from navigation and nature conservation in the study area. The meeting provided us

with valuable information of the historical development in terms of measures and rules implemented to manage the area. With the acquired information and knowledge, we identified the research problems to be addressed and the research design. We decided to study the intertemporal governance changes of the study area and its interconnections with the biophysical and ecological system, which can be nicely incorporated with the work from Sonia. Then it came to the point of collecting social data. With the help from Thomas and Viadonau, we reached out to the stakeholders involved in managing the area, mainly environmental NGOs with a natural conservation interest, and the navigation organizations. The data collection was a quite time-consuming process, but we were lucky enough to have most of the stakeholders on board and received high quality information from them.

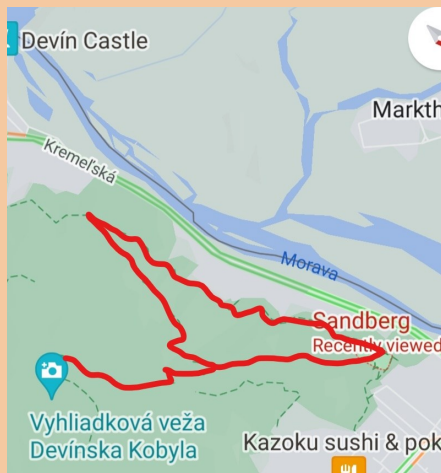
River and People

Research Diary by Yanhua Shi

“By far, you’ve probably seen how the secondment has evolved step by step, starting from problem identification, to research design, to data collection, and the next steps would be to dive into the data and of course, to finally write it up! The work is still continuing, and I’m very much looking forward to sharing more about what we’ll find out later on! ”

More: <https://iconn.network/journal/river-and-people/>

Up until this point, we have had the field trip, identified key research problems, developed the research plan, collected data... and that’s about one year passed. Guess what will be the next? Bingo, time to analyze the collected social and ecological data! Surely, I’m very excited to run the analysis and see what the results will tell us. Looking back to the past year, we have encountered challenges on almost all stages, but what I found extremely valuable is the chance of developing a project from scratch with researchers from another discipline, learning from the colleagues about something out of my little research niche, and the kindness and support from people who willingly participated and contributed to our study.



This article is more or less a short piece on the secondment experience. You are probably curious about where exactly that part of Danube is and what it looks like? Here you go! The image below shows the Danube east of Vienna at the border with Bratislava. The Danube comes from the Do-

nau-Auen National Park around the Braunsberg hill above Hainburg an der Donau and Bratislava to the left. It then merges with the Moravia river. You can reach the viewing point via a nice hiking tour starting from the Sandberg paleontological site within the Devínska Kobyla National Nature Reserve.



Secondments: When the will to collaborate encounters epistemic inertia

Mario Díaz

i-CONN secondments are a genius mechanism that allow us to start interdisciplinary collaborations with far away brilliant researchers from our network. Our secondments are one more of the relentless efforts that have been made to give collaboration the place it deserves in human evolution. Collaboration, often overlooked in favour of competition, is not only functional but also fun! However, it is remarkable how little has been said on how challenging collaboration can be between different disciplines.

I should have known better! I have an already interdisciplinary background in which I have gone from researching about the assembly mechanisms of tiny microbial organisms in the laboratory to diving in the muddy waters of the geopolitical underpinnings of a Green New Deal in the context of climate change. However, ways of the interdisciplinary research are inscrutable.

My first two secondments were, however, hitting a familiar nerve. I spent my first secondment learning about Social Network Analysis with Christina Prell and Ecological Network Analysis with Brian Fath when Covid-19 was pretty much everywhere and online collaboration was the rule. Learning social and ecological network analysis can be a fulfilling and enriching experience. Exploring the intricacies of relationships and interactions within social and ecological systems can provide valuable insights into their structures, dynamics, and functions. It offers a unique perspective on how networks shape our world, making it a fascinating and rewarding field of study.

In addition, my secondment with Damian Crilly on resource governance brought memories from my time in the Southern High Plains dealing with land degradation and farming communities. This was a painful (and beautiful, in a way) reminder of the inherent complexity associated with every governance system and the need for a systemic approach to tackle the always-emerging challenges from a capitalist system that is not compatible with any form of life.

The real challenge came when my secondments delved into the territory of the physicists and mathematicians. I felt a sense of bewilderment despite understanding the language. I learnt English many years ago and yet, it was the first time that even when understanding every single word in every single sentence, absolutely – absolutely – nothing made sense. This was remarkable. Collaborating with Marc-Thorsten Hütt and Selim in Bremen on minimal models and flux balance analysis and then with Vicky Papadopoulou and Michaelis in Cyprus on Graph Theory was an extremely enriching experience, but, at the same time, dauntingly confusing. The differences in methodologies, terminologies, and perspectives can lead to potential confusion and miscommunication. It requires open-mindedness, patience, and effective communication to bridge these disciplinary divides and work towards meaningful outcomes.

As researchers, we are constantly confronted with complex challenges that require us to think beyond the boundaries of our disciplines. Collaborative research across disciplines can be daunting, but with an open and collaborative mindset, it can also be an incredibly fulfilling and transformative experience. I am grateful for the lessons I learned and the relationships I formed, and I carry the invaluable experience of bridging disciplinary divides with me as I continue my academic journey.



Report – the hidden joys of administration!

When thinking about administration, most of us immediately have panic in their faces and imagine the horrors of endless bureaucracy. But it does not always have to be that way! Hear from Jenny King about her experiences as project administrator and what her role included besides the „usual“ stuff - trust me, you do not want to miss this!

Administration and deer semen - everything's connected!

Jenny King

When I was asked to write another article for the Newsletter, I agreed but have since been kicking myself. The first article I wrote (for the first edition of Connectivity Times) was easy as I just introduced myself. This time is harder – I've struggled to identify 'a hook' to hang the article on. Project management isn't particularly interesting, there is a lot of truth in the statement that 'good administration is invisible' and it isn't a source of amusing or insightful anecdote.

We've just had our 3rd Annual Workshop which was only the second gathering of the whole consortium due to Covid. Three years ago most of us were under lockdown and it is startling to see how quickly this is starting to be a faint memory. When the first edition of Connectivity Times was written, I hadn't met



any consortium members from outside Durham. Interactions with the Durham ESRs were limited to outdoor deliveries of food for newly arriving ESRs, which all felt very cloak-and-dagger (not that we broke any rules!) and occasional cold outdoor meet ups where everyone sat two metres apart and the cafes needed booking ages in advance.

i-CONN did a remarkable job of overcoming the obstacles posed by Covid to build relationships and evolve as a consortium, to the extent that when we finally met up it was common for people to feel that we already knew each other. This successful online engagement was recognised at our Interim Review and it was a pleasure to be a part of that.

Being the i-CONN Project manager has involved some unexpected associated activities – most notably helping with field-work. I had an enjoyable week in the Highlands of Scotland with [Mel Guirro](#) and Rebecca Hodge, driving the Ranger over

rutted tracks and keeping an eye open for wildlife while enjoying the amazing scenery and geology. As a result, my contribution to this newsletter is to provide the two most unattractive photographs of this edition. One is the aptly named “dog-sick slime mould” but I still can’t identify the odd lump of jelly in the second picture. Any suggestions? A browse online for (usually colourless) gelatinous matter is a fascinating delve into both wildlife and human foibles. A common explanation is that it is the egg mass from inside amphibians rejected by predators such as herons but that still appears to be inconclusive. Other suggestions involve deer semen, extra-terrestrial origins and sinister evidence of ‘chemtrails’!

I’ve also spent two days sampling rivers in North Yorkshire as part of Julia Costescu’s “[sample squad](#)”. Towards the end of one day when my fieldwork partner and I were in desperate need of a cup of tea, a loo and a handwash we were struggling to find an open café so we pulled into a pub. Unfortunately it proudly described itself as a “traditional pub”. Dotted around inside the pub were half a dozen men nursing a pint each.

One of our modellers could probably confirm that they were sat at the optimum positions to maintain the maximum distance from their nearest neighbour. The fact that it didn’t sell hot drinks puts it into the minority of pubs these days but isn’t so surprising. However the barman looked baffled when I asked for pineapple juice (“Oh, I don’t think we have any of that”).

I asked him what soft drinks he did have. He looked pained (and baffled again), peered suspiciously into a fridge that was almost empty and pulled out two bottles of concentrated orange juice. I didn’t check the use by date - I loathe the stuff anyway - by this time it was a matter of buying something so that we could justify using the toilets!

The next hurdle was their ‘cash only’ policy which we just managed. I suspect that we temporarily boosted the connectivity between the pub’s occupants when they started talking about us as soon as we left the premises. Or maybe we just warranted an indifferent shrug...



“The impact of network science is fundamental.”

An interview with Ginestra Bianconi

Ginestra Bianconi, valued member of the i-CONN Advisory Board and leading Network Scientist answered our questions about her life, her research and her perspectives on Connectivity Science.

Ginestra is Professor of Applied Mathematics at Queen Mary University of London and Alan Turing Fellow at the Alan Turing Institute. Her significant contributions to Network Science include the formulation of the Bianconi-Barabasi model and her research on higher-order and multilayer networks.



What sparked your interest in network science and especially multilayer networks?

I started to work in network science by chance, at the beginning of my PhD, because I found myself in the research group of Laszlo Barabasi right after the publication of his famous Barabasi-Albert model. Therefore, my PhD which in the original plans should have been focusing on surface growth models and the structure of quantum dots, changed rapidly direction. After two months of PhD, Laszlo asked me if I wanted to change the topic of my research focus and I enthusiastically accepted. I think this was one of the best decisions I took in my research life.

My interest on multilayer networks is a completely different story as I have already been working in network science for a decade. In 2010, there was the publication of the Nature paper by the Havlin group and I was very intrigued by the discontinuous percolation transition that they found.

So I started to study the critical phenomena and worked on that with my student Kun Zhao already during my time as Assistant Professor in Boston. Then, later, when I joined QMUL, the field was already blossoming and it became really clear why multilayers were important and how adopting a multilayer view of complex systems is a game changer for understanding the interplay between the network structure and dynamics. In QMUL, I found a very good research environment to develop these ideas and we conduct very good papers with collaborations within and across the department.

There is always a big role of chance on the way people choose to study given research subjects and the drive and bias of the research community in determining the research direction is clearly important. I think this is general for everybody, however, some people are interested in some research topics because they are fascinated by their possible use and applications. In my

case, I am always driven by the curiosity to learn more about the theory. I have a drive towards abstract thinking and towards finding relations between the mathematical structure of seemingly different objects of study.

What do you think, how does your work impact our society and the world around us? And the other way around, how does being a network scientist affect the way you look at the world?

Networks are everywhere and the impact of network science is fundamental. An example of how I see my role in the society is how I reacted during the pandemic. I felt the need to contribute to the modelling of epidemics, but instead of analysing data, I worked on theoretical problems that I think the COVID pandemic was raising that had not been already answered:

How does the epidemic spreading change if the population makes extensive use of a mobile app? How long can the infection plateaux be, and how difficult is to predict them? Are there possible higher-order mechanisms to predict super-spreading events?

I like applied work and I keep updated with that but I am happy to find myself in a special spot in which I can provide some theoretical answers that might be useful for applications, sometimes really making an impact on some applications.

My way to look at the world is very abstract and my preferred object of study is mathematics itself. My background is physics, however, my intuition is mostly driven by my understanding of the mathematical equations that describe a phenomenon rather than by the phenomenon itself.

Why do you think working in network science is so special ?

I think that networks are special because everything in nature is interacting, so networks are a fundamental object of study.

There is a drive in science towards interdisciplinary research and networks are really interdisciplinary, being found in river networks, brains, trade networks, climate networks ect. This makes network science a vibrant research community that can find input and insights from many different fields.

Also from the theory side, network theory includes statistical mechanics, inference, dynamical systems, combinatorics, topology, discrete geometry. It is an ever expanding subject, always evolving and developing in different directions.

The hope is that in this way we will be able to really say something of fundamental importance that distinct disciplines have not been able to formulate, for instance regarding the functioning of the brain.

What has been for you the greatest insight in network science in the last years?

My current passion is higher-order networks and I have two preferred works on the subject at the interface between topology and dynamical systems.

In the first work (Millan, et. al PRL 2020), we study the synchronization dynamics of topological signals. Topological signals are dynamical variables not only associated to the nodes but also associated to the links and even to the triangles of a higher-order network. For instance, topological signals associated to the edges can be fluxes in biological transport networks or synaptic signals between neurons.

In our work, we show that these signals can synchronize, however, their topological synchronization displays specific higher-order topological features. Indeed, the dynamics end up to be mostly localized in the holes of the higher-order networks, showing that the dynamics can “learn” the topology, i.e. where the holes are. This shows that cycles of networks are key for the topological synchronization of edge signals. In the brain, we know how feedback loops are important so it would be interesting to explore if this new critical phenomenon can lead to further understanding of the role of these feedback loops in brain dynamics.

In the second work (Sun et al. Nature Communications 2023), we show that the topology of the higher-order networks can become itself dynamical. One important class of topological objects are the connected components, and among those the giant component plays a special role as its existence is a necessity for the definition of any collective dynamical process in the network. Typically, the connectivity of the network is studied with percolation determining the size of the giant component

after a damage of the links. However, standard percolation theory cannot account for situations in which the giant component is highly dynamic, like in climate or in functional brain networks (think of the videos of the resting state of the brain showing how the giant component changes in time). In Sun et al., we show that triadic interaction, i.e. higher-order interactions in which one node can regulate the interaction between two other nodes, can describe a giant component that blinks (oscillating periodically between different states) or that can change chaotically in time, affecting different sets of nodes of very different size over time. We think that these results will find applications in different fields from brain research to climate.

These works are not only the ones that I prefer among my recent outputs for their scientific content but I like them also because the work on these papers has been a very fun and enriching experience, and I should thank both teams of excellent collaborators and especially Ana Millan and Hanlin Sun which both were PhD student at the time we published these works.

What do you think will be the next big breakthrough in network science?

It is difficult to predict but I think research on higher-order networks is very promising.

Is there any idea, project or experiment that you would consider your greatest failure? And why? How would you deal with that?

During a life in research, one learns that the success of one's work is often difficult to predict. I had experienced having great expectation for a work that then was not a big success.

How important is a work is not decided by the authors but by the research community: how many people find your work interesting and stimulating for further research. There are also works that become popular for a reasons that you did not expect originally.

Every publications should be written with good care, but then, what you wrote is in the hands of the community that ultimately decides if it is interesting. I do not go so far that I do not write a paper if I do not think there is public for it. I think it is good to write papers that you find interesting according to your internal drive and motivation, but then of course one should also pay attention at how the scientific community respond to each work. It is a feedback loop as research progress is collective experience.

Why did you join i-CONN in the first place and did your involvement benefit you in any way?

I think i-CONN is a great activity of crucial importance for the training of the next generation in network science and I greatly

enjoy giving seminars and interact with i-CONN community during the years.

What do you think are the differences between collaborative projects like i-CONN and doing a more traditional individual PhD project? Do you think one is better than the other for the PhD candidate and the field in general?

I think this gives a great environment for ideas to develop and having a great environment to do research is essential for the flourishing of a field.

How do you see the future, for you personally and for the field of network science in general?

I think there is a lot of promise for research in theory and application of network science and I see a bright future for their interactions.

What is your advice for the next generation of network scientists?

Try to find joy in what you do: there is no point of doing research if it is something you do not enjoy and have fun with. This implies finding your way to do research, for me the way has always been to choose the things that are easier to do for me and that I enjoy the most.

I think that also it is always important to be humble— as we always know very little also after years of study and research — and try to be a bit childish: look at the world with curiosity and with a fresh look — there is always a lot to learn from nature.

This childish look at nature will hopefully accompany you for all your research career, keeping you young in spirit and giving you the motivation to pursue your path also in difficult times.



Research Diary previews:

The importance of letting our rivers flow

Sonia Recinos

“I attended the Dam Removal in Europe conference a few years ago, which, like many other meetings in the last three years, was held in Zoom. “

More: <https://iconn.network/journal/the-importance-of-letting-our-rivers-flow/>

Outdoor learning

Mel Guirro

“This field trip was one of the most memorable moments of my PhD journey. In addition to collecting data and better understanding my study area, it was great to visit this beautiful place in the Scottish Highlands, especially with the early autumnal colours.”

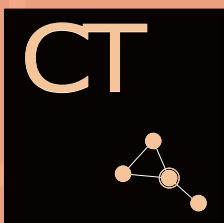
More: <https://iconn.network/journal/outdoor-learning/>

A Summer of Conferences

Deborah Priß

“Summertime is conference time! Or, usually, summertime for archaeologists is fieldwork time. But for archaeologists like me who are only doing desk-based work and don’t travel the world to excavate or survey exciting sites, traveling the world to attend exciting conferences is the next best thing. ”

More: <https://iconn.network/journal/a-summer-of-conferences/>



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