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Cybernetic Lenses for Designing and Living in a Complex World

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2. Context and Aim of Workshop

2.1 Background and Motivation

Our world is moving through a period of global crisis and change with the COVID-19 pandemic and increasingly extreme climate change-related events such as mega-fires and heatwaves while booming with technological innovation around AI-enabled systems. From this situation, we are learning about the fragility of the systems we live in. As such, considering alternative design research approaches to investigate, design and live in complex environments is vital for our future. In this hands-on half day workshop called “Cybernetic Lenses for Designing and Living in a Complex World” we introduce cybernetics and demonstrate its applicability to study complex relations between humans, non-humans, technology, and the environment in which they coexist to reveal opportunities that can steer us towards more

positive futures. With this context, our goal is to provide theory about how to use the cybernetic lenses we present and follow with practical exercises so participants can explore and incorporate this design research approach into their practice.

2.2 Cybernetics

In ancient Greece, Plato first quoted "Kubernetes", referring to "helmsperson", and meaning the art of steering to navigate (François, 1999). Post-WWII, Norbert Weiner denoted the term "Cybernetics" as “control and communication in the animal and the machine” (Wiener, 2019), focusing on studying feedback loops, and patterns of interaction between biological and computational actors and the environment.

Cybernetics provided a way of thinking to study circular processes and how meaning is created between actors to investigate and design systems where humans, machines, and the environment interact (Sweeting, 2018). Giving way to biologically inspired computing and neural nets in artificial intelligence, conceptualizing principles of automation and robotics, prescribing humans' role in technology, and influencing the world we live in today.

The "cyber" prefix in cybernetics is used in association with computing, for example, cyberspace, cyberpunk, cybersecurity, cybersex, cyber-physical; these terms can be overwhelming for designers and researchers looking to engage with cybernetics as an approach to study complex relations. To revisit cybernetics for today's socio-technical context, this workshop presents cybernetic lenses and their application to two case studies to guide participants.

2.3 Cybernetic Lenses for Designing and Living in a Complex World

Today's application of cybernetics is vital due to advances that have progressed the technological paradigm of computational machinery shaping the complex world we live in. From supporting software infrastructure in every area of our life to computation that learns and adapts to the user's context while sensing, interpreting, and acting on vast amounts of data.

We present three lenses inspired by cybernetics thinking helpful to investigate and design technological interventions in complex environments.

Lens One: observed systems - controlling relationships

This lens explores computational systems designed with self-regulating behavior to respond to the environment and regain a desired state. Examples include, self-regulating robot creatures, such as a three-wheeled light-seeking tortoise (Hutt et al., 2005), that exhibited self-regulating behavior by continuously sensing light and using a feedback loop mechanism to recalculate its orientation and follow the light source.

This lens provides a valuable perspective to draw closed-loop boundaries in a system, where the practitioner defines the parameters for self-regulating behavior in a computational actor, so the actor steers its behavior towards a goal. This closed-loop boundary enables the practitioner to observe the system from a third-person perspective and experiment with its dynamics.

Lens Two: observing systems - evolving relationships

This lens proposes that all systems are open and intertwined in a complex multi-feedback interdependent relation. Examples include how a human piano player, via a modified piano that displays light colors according to the melodies played, can enter a performative state as if the piano was an extension of their body (Pickering, 2002). Another example is a partnership between a rider and a modified eBike that senses traffic light data to adjust engine support and assist the rider in catching traffic lights on green (Andres et al., 2019).

This lens acknowledges the biological, material, computational actors, and the environment as one ecosystem that co-evolves over micro, human, and macro time scales. Thus, while the first lens offers a third-person perspective to observe closed-loop boundary complex systems, the second lens offers a first-person perspective, where the observer is part of an open co-evolving complex system.

Lens Three: Mutually observing systems - social relationship

This lens reminds us of the larger social dimension where mutually observing systems are within—as the singer is to the orchestra and the audience—and mutually observation and acting occurs to create something larger than the sum of its parts. Examples include humans and computation working in harmony to adapt to the changing environment. Such as adaptive architectures, where adaptive computation orchestrates changes in the built environment in response to human or infrastructure needs, and humans adapt to such changes (Haque, 2007). Another example is tele-robots to enable remote participation in previously considered human-only practices, such as mediation of funeral ceremonies, resulting in emerging social and cultural relationships through technology (Arnold et al., 2021).

This lens can empower practitioners to think more broadly about their technological contributions. Reflecting on the social dimension our systems and choices contribute to when mutually observing and acting alongside other systems.

3. Planned Activities and Expected Outcomes

3.1 Organizers, Multidisciplinary and Inclusive by Design

Our team brings a range of experiences in design research and cybernetics and includes senior, mid and early career members. The team is experienced at developing and delivering virtual, hybrid, and in-person workshops.

Workshop duration: Half day, approx. 3-4 hours. **Delivery mode**: Virtual.

Before the workshop, we will survey participants to select two from the following complex systems scenarios where humans, non-humans, and technology intersect across time: “adaptive bodies and adaptive built environments”, “human-machine symbiosis in every day”, “sustainability for regenerative practices”. The survey's learnings will help organizers tailor the contents for the medium of delivery to ensure an excellent learning experience for participants.

Workshop activities and outcomes

	Activity	**Time**	**Objective**	**Outcomes**
1	Welcome and Introductions in Pecha kucha format where each participant shows ~20 slides for 20 seconds to introduce their work and interest in the workshop.	30 mins	To learn about the group coming together.	To build connections in the DRS and promote empathy and understanding for the workshop.
2	Presentation: Cybernetic Lenses for Designing and Living in a Complex World.	30	Introduce cybernetics and the cybernetic lenses for studying and designing technological interventions in complex environments.	Provide participants with a starting cybernetics foundation to observe and study complex environments in which humans, non-humans and technology coexist.
3	Break	15		
4	Exercise one – case study, cybernetics in practice. Introduction 5 Group work - applying the lenses 10 Groups show and tell 10 Discussion 10	35	To put to practice the cybernetic lenses to study a scenario. We will survey participants prior the workshop to select two from the following complex systems scenarios to use in the workshop: “adaptive bodies and adaptive built environments”, “human-machine symbiosis in the everyday”, “sustainability for regenerative practices”.	Scenario one. To guide participants in applying the cybernetic lenses as a design research approach to study human, non-human, technology relationships in complex environments.
5	Exercise two – case study, cybernetics in practice. Introduction 5 Group work - applying the lenses 10 Groups show and tell 10 Discussion 10	35	To put to practice the cybernetic lenses to study a situation.	Scenario two. To let participants apply the cybernetic lenses more independently as a design research approach to study human, non-human, technology relationships in complex environments.
6	Break	15		
7	Summary, reflections and thank you	20	Recap: cybernetic lenses, open discussion, identify next steps and thank participants.	Identify publication venue and set up working group to begin work.

4. Intended Audience

We hope to bring together designers, systems thinkers, engineers, researchers, practitioners, and adjacent disciplines engaging with design research and cybernetics to learn from their multidisciplinary explorations in today's socio-technical context. We welcome participants across all experience levels, from newcomers looking to learn what is and how to apply cybernetics in their practice to experienced practitioners looking to learn from contemporary and multidisciplinary cybernetic explorations.

We expect 15-25 participants.

5. Space and Equipment Required

Virtual arrangements:

- We will arrange Zoom or Teams with live captioning for accessibility and Miro boards for the group's sessions.

Strategies for Asynchronous Participation

- A slack workspace will be created to support collaboration, where reading materials, videos, polls about workshop contents and questions will be shared for all to participate.
- The cybernetic case study presentation and the participants pecha kucha will be recorded and shared with participants and with the community.
- Live illustration will be used to summarise conversations and ideas, and these summaries will also be shared far and wide with the community.

Strategies for Accessibility Support

- Automatic Zoom closed captioning will be used as part of the premium Zoom service and included into the recordings.
- The workshop slides will be available to participants during and post sessions.
- Once participants are registered, we will ask what accessibility needs they might have, and we will with the workshop chairs to ensure they thoroughly enjoy and engage in the workshop.

6. Potential Outputs

The outputs of this workshop are multiple, from bringing together and growing the systems community using design research approaches to study, live, and design in complex environments, bringing newcomers to DRS from other communities, to presenting a contemporary take on cybernetics for the 21st century as a design research approach applicable to various domains. In addition, we hope to publish the learnings of the workshop as an article or paper via DRS including the live illustration synthesis of the workshop learnings.

7. References

Andres, J., Kari, T., von Kaenel, J., & Mueller, F. “Floyd.” (2019). Co-Riding With My EBike to Get Green Lights. *Proceedings of the 2019 on Designing Interactive Systems Conference*, 1251–1263. https://doi.org/10.1145/3322276.3322307

Arnold, M., Gould, H., Kohn, T., Nansen, B., & Allison, F. (2021). Cybernetic Funeral Systems. *2021 IEEE Conference on Norbert Wiener in the 21st Century (21CW)*, 1–4. https://doi.org/10.1109/21CW48944.2021.9532545

François, C. (1999). Systemics and cybernetics in a historical perspective. *Systems Research and Behavioral Science: The Official Journal of the International Federation for Systems Research*, *16*(3), 203–219.

Haque, U. (2007). The architectural relevance of Gordon Pask. *Architectural Design*, *77*(4), 54–61.

Hutt, B., Warwick, K., & Goodhew, I. (2005). Emergent behaviour in autonomous robots. In *In Design and Information in Biology: From Molecules to Systems* (Vol. 2). WIT Press.

Pickering, A. (2002). Cybernetics and the mangle: Ashby, Beer and Pask. *Social Studies of Science*, *32*(3), 413–437.

Sweeting, B. (2018). Wicked Problems in Design and Ethics. In P. Jones & K. Kijima (Eds.), *Systemic Design: Theory, Methods, and Practice* (pp. 119–143). Springer Japan. https://doi.org/10.1007/978-4-431-55639-8_5

Wiener, N. (2019). *Cybernetics or Control and Communication in the Animal and the Machine*. MIT press.

About the Organisers:

Josh Andres is a Senior Lecturer in the School of Cybernetics at the Australian National University (ANU). His research advances human-cyber-physical AI systems using cybernetic lenses. Josh is an associate with the WellthLab at Southampton U. UK, and the Exertion Games Lab Monash U. AU. His work has been covered by Openbci, Newatlas, The Age, Zdnet and Insiderobotics, and published at top tier conferences such as CHI, DIS, CHIPLAY, IUI, TEI, KDD and UbiComp. Before the ANU, he spent seven years at IBM Research on HCI, UX, AI and health, and Blockchain, where he co-invented over 20 patents. The decade prior, he worked in UX and innovation, leading the design of multi-device experiences enjoyed by millions of users.

Alex Zafiroglu is a Professor of Cybernetics, School of Cybernetics, Australian National University. A cultural anthropologist by training, Dr. Zafiroglu is currently Professor and Deputy Director at the School of Cybernetics, Australian National University. Prior to this, she was with Intel Corporation, where during her 15-year stint she worked in various divisions including People and Practices, Digital Home, Client Computing, and the Internet of Things.

Paul Wong is a Senior Lecturer at 3Ai within the School of Cybernetics. He completed his PhD with the Automated Reasoning Group in the Research School of Information Sciences and Engineering at the

ANU. Paul was formerly a lecturer in Software Engineering at the University of Wollongong, a Senior Policy Analyst with the Commonwealth Grants Commission, and a Defence Analyst with the Defence Science and Technology Organisation. Over the last decade, Paul has been a data practitioner covering all aspects of the strategic use of data as an enterprise and national asset. Paul has managed enterprise class systems and data, played a key role in the establishment of a national consortium to support digital research infrastructure, and contributed to the improvement of research data management practices nationally. Paul also has a love-hate relationship with his collection of guitars.

Professor Katherine A. Daniell, BEng(Civil)(Hons)/BA (Adel.), PhD (ANU/AgroParisTech, France), MIEAust, is a transdisciplinary academic at the Australian National University's 3A Institute in the School of Cybernetics, Fenner School of Environment and Society, and Institute for Water Futures. Trained in engineering, arts and public policy, her work bridges multiple domains including multi-level governance, participatory processes, risk management, sustainability science, river basin management, politics and cultures of innovation, and international science and technology cooperation. Katherine currently convenes the ANU Master of Applied Cybernetics, and serves as a member of the National Committee on Water Engineering (Engineers Australia), Director and Board Member of the Peter Cullen Water and Environment Trust, a member of the Initiatives of the Future of Great Rivers, Editor of the Australasian Journal of Water Resources and President of the Australian-French Association for Research and Innovation Inc.

Mina Henein is a lecturer and researcher at the 3A Institute in the School of Cybernetics at the Australian National University. He received his Ph.D. at the Australian National University, and the Australian Centre of Excellence for Robotic Vision working on localisation and mapping algorithms for autonomous robots. His research interests lie at the intersection of robotics, computer vision, artificial intelligence, sustainability and responsibility of algorithms. With a background in mechatronics engineering, advanced robotics, business intelligence and market analysis, his work focuses on tangible impacts on today's society. He currently serves as a reviewer for a number of international robotics conferences and journals and has been involved in the entrepreneurial circle in Australia and worldwide for the last five years.

Xuanying Zhu is a lecturer and researcher at the 3A Institute in the School of Cybernetics at the Australian National University (ANU). Xuanying is completing her PhD at the ANU focusing on using human body signals and machine learning algorithms to recognise depression and deception. She has a broad range of research interests in the field of Physiological Sensing, Human-Computer Interaction (HCI), Artificial Intelligence (AI) and their social implications. She serves as a community member of the International Conference on Neural Information

Processing (ICONIP) and as a reviewer for several international conferences on HCI, Cybernetics and AI.

Michael Arnold is Professor and Head of Discipline in the History and Philosophy of Science Programme at the University of Melbourne. His on-going research activities lie at the intersection of contemporary technologies and daily life, including studies of online memorials, body disposal and other technologies associated with death, technologies used in domestic settings and in medical settings. Michael is also interested in philosophical approaches to technologies, in particular, Heidegger, Actor-Network Theory, and Object Oriented Ontology. Michael has been Chief Investigator on many research projects, and has co-authored 4 research books and over 150 other research publications.

Ben Sweeting teaches architecture and design at the University of Brighton, Brighton, UK. Ben's work is situated in the fields of cybernetics, systemic design, and architectural theory, with focuses including ethics, place, and methodology. Ben is a member of the Executive Committee of the American Society for Cybernetics (2018-present) and has guest edited journals including Kybernetes, Cybernetics and Human Knowing, and Constructivist Foundations.

Delia Pembrey MacNamara is a past-President of the International Society for the Systems Sciences, a Trustee of the American Society for Cybernetics and an assistant director at Services Australia Intelligent Automation Centre of Excellence, Research, Advisory and Development. Delia is completing her PhD at the University of Hull focusing on the ontology of Boundary and systemics in sociotechnical activity systems using a critical systems and cybernetic approach. Delia's research has led her to develop perspectives from the viewpoint of the artificial intelligence and her research interests include Human Development and Learning, Gender Pathologies, Physiological Sensing, Humanoid Robotics, Human-Computer Interaction (HCI), Artificial Intelligence (AI) and their systemic impacts.

Dr Ariella Helfgott is an Experienced Senior Researcher with a demonstrated history of working across disciplines, sectors and social worlds to achieve sustainable and equitable futures. She is a Senior Researcher at the University of Adelaide, and a founding Director of Collaborative Futures. Ariella undertakes Multi-Actor Collaborative Action Research supporting sustainability transitions. Her research spans conceptual and mathematical modeling of system resilience and adaptability, through to participatory approaches to building resilience and adaptive capacity on-the-ground. Within the later, she brings together stakeholders across and within multiple decision-making levels and engages them in programs that develop strategic capacity, for example exploratory scenarios, visioning and back-casting and resilience-based planning.