Intelligent Systems Lab Annual Report
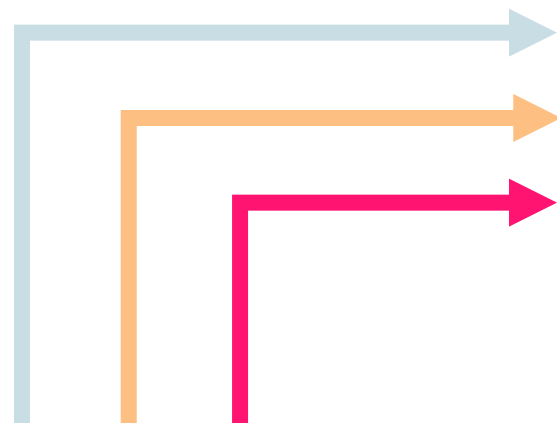
Impact through **S**ystems **L**earning
Dec 2024
From Concepts to Communities: Impacting the Future.
https://intelsyslab.com

Executive Summary

The past two years have marked a period of extraordinary growth for the lab, expanding to twenty-four active researchers across three continents engaged in fifteen research projects, four special projects and four project clusters split into sixteen individual components. The lab is focused on developing intelligent systems integrated enabling technologies- *"innovations that, when deployed independently or in conjunction with complementary technologies, drive transformative advances in performance capabilities or catalyze fundamental shifts in user and cultural possibilities."*
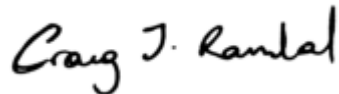
The philosophy for selecting research problems stems from regional and global challenges that require novel solutions. These challenges may lead to developing new regional industries, creating evidence-based policies, and rapidly researching, developing, and implementing sophisticated systems.

We end 2024, celebrating:

1. The ideation and continued development of the ISL-NANO software framework, funded by CR&P Fund: 3.NOV23.06.
2. Verified nitrification of water from our in-house low-powered plasma systems.
3. Completion of water resource management block-chain solutions for water providers partnered with Global Water Partnership-Caribbean.
4. Initiating and processing MoUs with international and regional institutions for research, capacity building and policy creation opportunities.

We close this remarkable year, inspired by the possibilities that lie ahead—not just in advancing intelligent systems, but in strengthening the collaborative networks and partnerships that will help transform these innovations into real-world solutions for communities across the globe.

Yours sincerely,

Craig J. Ramlal
Principal Investigator

Members

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Principal Investigator
Chair, Advisory Board

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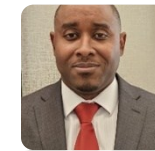
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Dr Daniel Ringis
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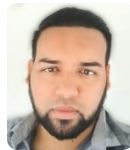
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Chane Gomes
Researcher

Kyle Lochan
Researcher

Non-Confidential

Contents

Publications & Grants 2024

Funding

In Progress Grants:

1. CR&P Fund: 3.NOV23.06 -Toward Faithful AI Systems: A Multi-Agent Unfalsified Framework, TTD $78,400 (In: 2023-ongoing)
2. Global Water Partnership-Caribbean: Advancing Water Quality through Blockchain Technology (funding: undisclosed)

Past Funding:

1. Ministry of Planning, GoRTT, Research and Development Initiative: Hospitech, TTD $650,000
2. Ministry of Planning, GoRTT, Research and Development Initiative ATIM: Autonomous Transmission Infrastructure Monitoring, TTD $600,000

Publications

Accepted 2024:

3. A Singh, Micah Phillip, Craig J. Ramlal, " Towards Automated Frequency Response Analysis of Power Transformers with Deep Learning." Applied Artificial Intelligence

Published 2024:

4. Mohammed, Amir, Craig J. Ramlal, Lincoln Marine, and Fasil Muddeen. "Resilient Event Triggered Interval Type-2 Fuzzy Sliding Mode Control for Connected and Autonomous Vehicles Subjected to Multiple Cyber Attacks." Journal of Advanced Transportation 2024, no. 1 (2024): 2790548.

Submitted 2024:

5. "State-Adversarial Neuro-dynamic Nonlinear $PI^\lambda D^\mu$ Virtual Inertia Control", CJ. Ramlal, V. Pariag, A. Singh and K. Hunte.
6. "Safety-Constrained Cooperative Transportation Control of a Quadrotor Lifting System", C. Coker, CJ. Ramlal, A. Singh and C. Maharaj
7. "SimuNEX: A 3D Simulation Framework for Teaching Control Systems", L. Bissessar, CJ. Ramlal and A. Singh
8. "Nonlinear Robust-Adaptive Geometric Cooperative Multicopter Control for Fighting Wildfires", C. Coker, CJ. Ramlal, A. Singh and C. Maharaj

9. "Blockchain Mechanisms for Sustainable Water Practices in the Caribbean Region", CJ Ramlal, L. Bissessar, S Allong, D Phagoo, S Lewis, K Martinez

Past Publications

10. Phillip, Micah, Arvind Singh, and Craig J. Ramlal. "Narrow Band Frequency Response Analysis of Power Transformers with Deep Learning." Energies 16, no. 17 (2023): 6347.

11. Mungal, M. J., A. Singh, C. J. Ramlal, and J. Colthrust. "Sensitivity analysis of the unit commitment problem to guide data acquisition investments in a small island developing state: A case study." Results in Engineering 18 (2023): 101191.

12. Hunte, Kyle, Craig J. Ramlal, and Jingang Yi. "Dynamic Path Planning for Multiple Robots Transporting Objects in a Deformable Sheet." IFAC-PapersOnLine 56, no. 3 (2023): 505-510.

13. Mohammed, Amir, Fasil Muddeen, Lincoln Marine, and Craig J. Ramlal. "The Exigency for Resilient and Cyber-Secure Critical Infrastructure in the Caribbean." West Indian Journal of Engineering 45, no. 2 (2023).

14. Manninen, Henri, Craig J. Ramlal, Arvind Singh, Jako Kilter, and Mart Landsberg. "Multi-stage deep learning networks for automated assessment of electricity transmission infrastructure using fly-by images." Electric Power Systems Research 209 (2022): 107948.

15. Mohammed, Amir, Fasil Muddeen, Craig J. Ramlal, and Lincoln Marine. "A Comprehensive Review of Fault Tolerant and Resilient Cyber-Secure strategies for Critical Infrastructure Protection." The Industrial Engineering and Management Journal 1, no. 1 (2022): 66-76.

16. Manninen, Henri, Craig J. Ramlal, Arvind Singh, Sean Rocke, Jako Kilter, and Mart Landsberg. "Toward automatic condition assessment of high-voltage transmission infrastructure using deep learning techniques." International Journal of Electrical Power & Energy Systems 128 (2021): 106726.

17. Ramlal, Craig J., Arvind Singh, Sean Rocke, Henri Manninen, Jako Kilter, and Mart Landsberg. "Toward automated utility pole condition monitoring: A deep learning approach." In 2020 IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe), pp. 255-259. IEEE, 2020.

18. Ramlal, Craig J., Arvind Singh, and Sean Rocke. "Repetitive learning frequency control for energy intensive corporate microgrids subject to Cyclic Batch Loads." In 2020 IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe), pp. 349-353. IEEE, 2020.

19. Mohammed, Amir, Craig J. Ramlal, Arvind Singh, Sean Rocke, and Daniel Goitia. "A simulation framework

for controlled critical infrastructures subject to natural disasters." (2020).

20. Singh, Arvind, Sean Rocke, Akash Pooransingh, and Craig J. Ramlal. "Improving student engagement in teaching electric machines through blended learning." IEEE Transactions on Education 62, no. 4 (2019): 297-304.

21. Ramlal, Craig J., Arvind Singh, Sean Rocke, and Michael Sutherland. "Decentralized Fuzzy H_∞-Iterative Learning LFC With Time-Varying Communication Delays and Parametric Uncertainties." IEEE Transactions on power systems 34, no. 6 (2019): 4718-4727.

22. Dookie, Isa, Sean Rocke, Arvind Singh, and Craig J. Ramlal. "Evaluating wind speed probability distribution models with a novel goodness of fit metric: a Trinidad and Tobago case study." International journal of energy and environmental engineering 9 (2018): 323-339.

ISL's Road to R&D Impact
Overview

The proliferation of artificial intelligence, intelligence-enabled systems, and advanced technologies like robotics and plasma systems has transformed the technological landscape. As these systems are becoming increasingly integrated into societal infrastructure—from cyber-physical systems to industrial to consumer applications. We observe a corresponding need for frameworks that ensure their safety, contextual appropriateness and ethical implementation. Acknowledging this global trend, we also recognize the unique challenges faced by the Caribbean region, where limited computational resources and infrastructural bottlenecks can impede large-scale AI and hardware-intensive development. Furthermore, there are insufficient frameworks for ethical data collection and curation that respect Caribbean digital sovereignty. However, the region still requires feasible, robust, and intelligent systems including cutting-edge hardware solutions that address local realities within existing infrastructural constraints.

In this context, a notable gap emerges: the absence of foundational models, fundamental AI systems, and hardware innovations built with Caribbean data and contexts, which could serve as enabling technologies to propel intelligent systems adoption and research across the region. We acknowledge that without such systems and the corresponding computational efficiencies—researchers, developers, innovators and entrepreneurs lack a critical resource for driving widespread innovation and remain constrained in their efforts to produce cutting-edge applications that genuinely reflect the region's cultural, linguistic, and socio-economic nuances while advancing areas like autonomous systems and advanced plasma applications.

This reality has shaped our method to be inclusive and collaborative and shaped our research toward the selection of problems from both regional and global challenges that demand novel solutions that have the potential to drive the development of new regional industries, the creation of evidence-based policies, and the rapid research, development, and implementation of sophisticated systems. Simultaneously, we observe that real impact and sustainable adoption of AI, intelligent-enabled systems and hardware-intensive solutions across the region necessitate strategic partnerships among multilateral, government, private, development, CSO, and academic institutions. These collaborations would advise on potential research directions, work together to implement sector-specific applications in various countries, and partner to develop evidence-based policies.

Our research, development and implementation process involves:
1. Generating knowledge, and novel theories and disseminating them to the scientific community.
2. Implementing theories as prototypical systems and conducting in-situ studies.
3. Working with stakeholders to deploy prototypes in real-world scenarios, monitoring outcomes and collecting data.
4. Refining technologies and disseminating information to the wider public about their purpose, capabilities, and limitations while partnering with incubators for sector-specific applications.
5. Partnering with multilateral organizations and national policy bodies to provide technical expertise and generate evidence-based policies.

Core Technologies

The Intelligent Systems Lab focuses on the following core technologies:

1. **Artificial Intelligence:** Generation of mathematical theories and algorithms, their practical implementation into software and the construction of hardware processing systems.
2. **Applied Intelligent Systems:** Research, design and implementation of AI/ML systems from ISL's AI framework to solve real-world problems.
3. **Autonomous Systems:** The study of control theory and advanced decision systems and their applications to robotics, industrial, energy and software systems.

Project Categories

- **Research Projects:**
  - **Purpose:** Serve as the space for new ideas, allowing researchers to establish theoretical underpinnings and validate initial concepts.
  - **Scope:** Focused investigations that guide subsequent endeavours typically involving lab scale models and testing.
  - **Outcome:** Provide foundational insights and proofs-of-concept, indicating which topics hold promise for deeper or broader exploration and impact.

- **Project Clusters:**
  - **Purpose:** Create foundational technological platforms and frameworks that can support multiple future applications.
  - **Scope:** Complex, resource-intensive initiatives often requiring multidisciplinary teams and longer timelines.
  - **Outcome:** Establish core technological capabilities and standards that become the building blocks for future innovations across multiple sectors.

- **Special Projects:**
  - **Purpose:** Rapidly prototype and translate existing research for specific industry applications or market opportunities, often in collaboration with external parties.
  - **Scope:** Time-bound initiatives with clear deliverables, focused on single-sector implementation and quick iteration based on stakeholder feedback.
  - **Outcome:** Generate immediate practical value through customized applications while building case studies and market validation for broader adoption.

ISL Project Catalogue 2024
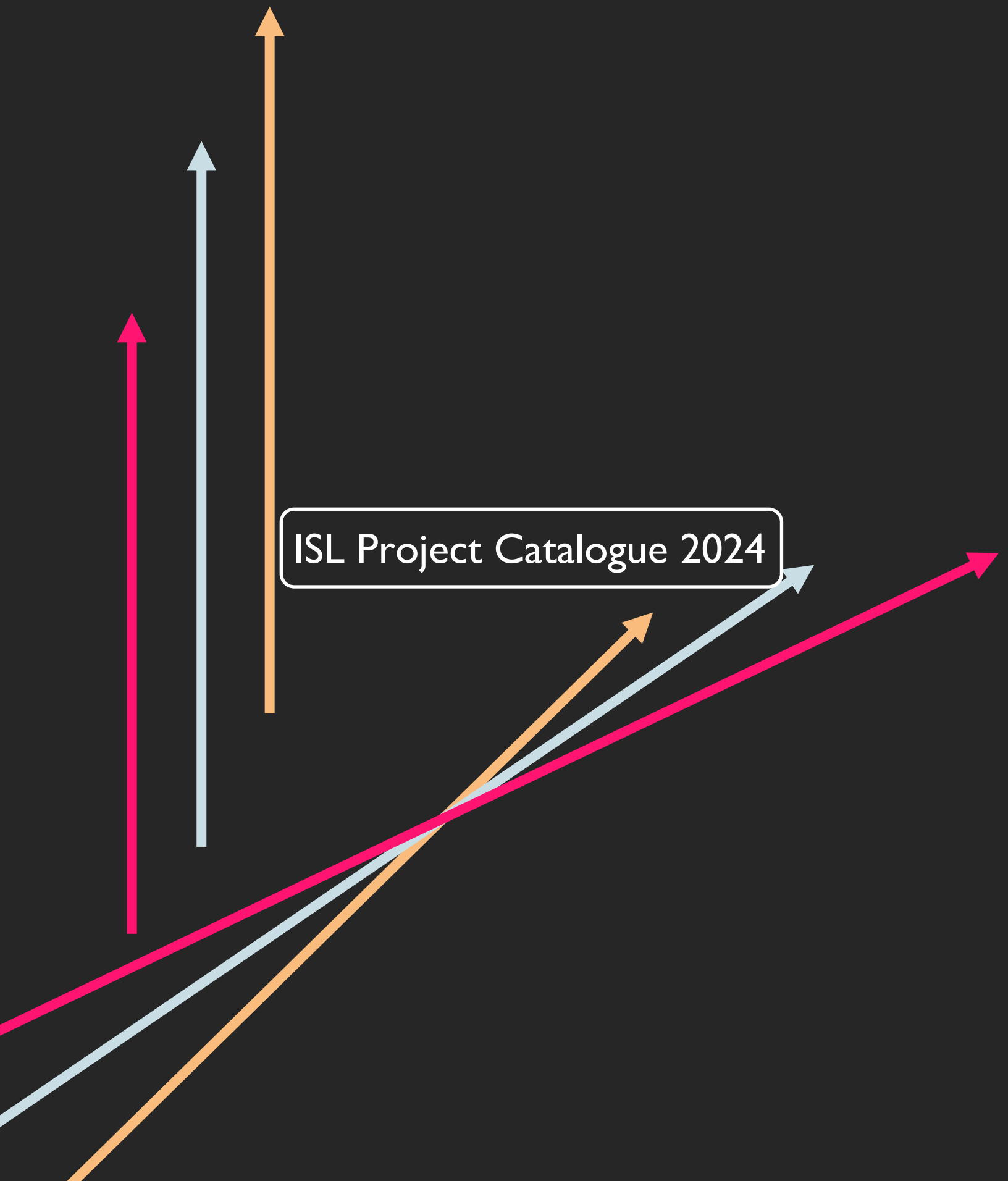
ISL Research Projects (REPR)

1.DEFT: Cooperative Control and Path-Planning of Multiple Robots Transporting Objects on a Deformable Sheet

Robotic manipulation of objects has many applications and can be found in industries that range from manufacturing to service robots. Unfortunately, most robotic manipulation research has focused on rigid objects due to the challenges associated with rigid body objects. Sensing deformation, the infinite degrees of freedom, and the nonlinearity of the models are a few of the important challenges associated with deformable object manipulation. This research project focuses on the design of novel path-planning and control algorithms for a multi-robot transportation system that uses a deformable sheet to transport and manipulate objects.
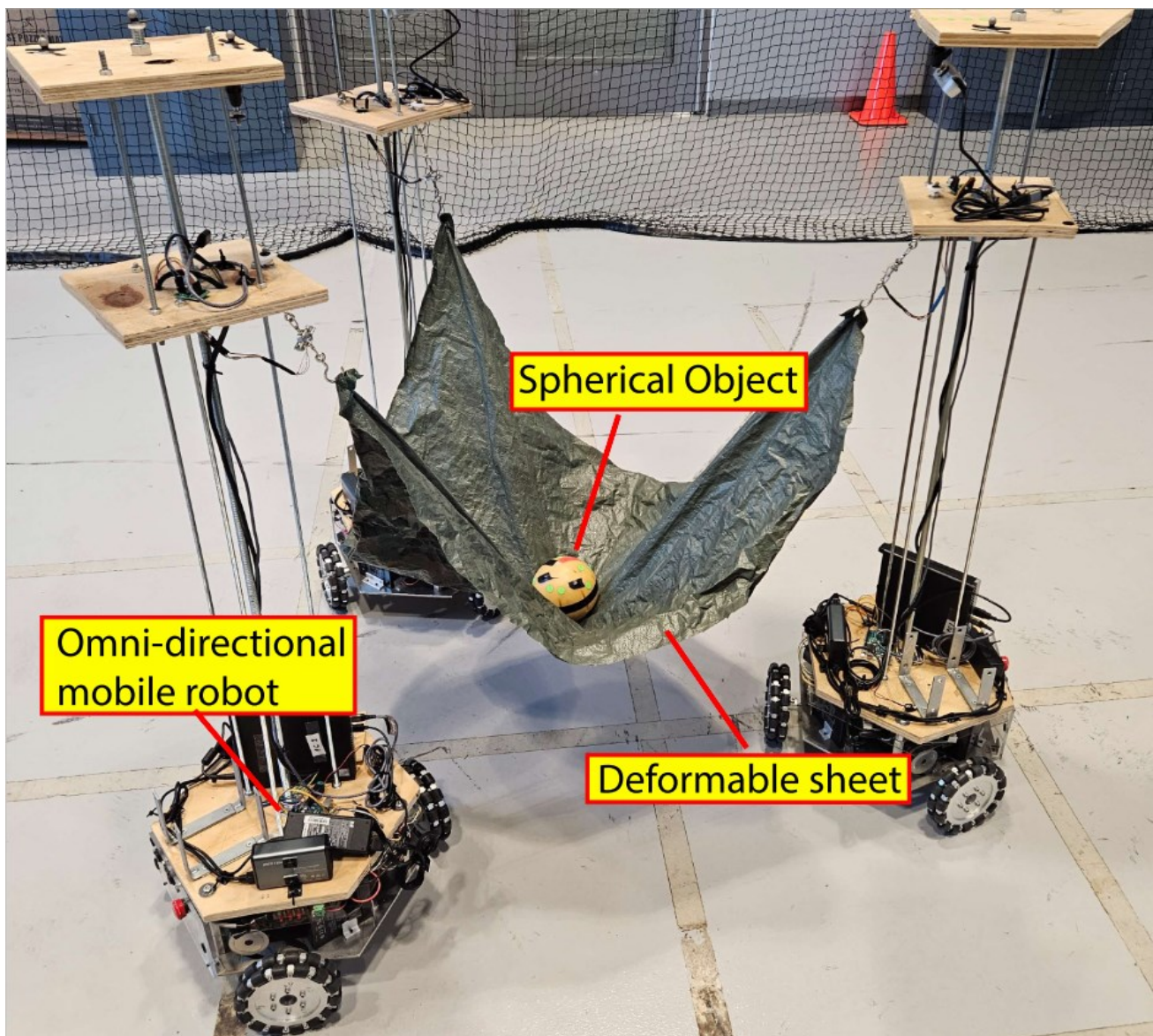

Figure 1: 3 Omni-directional autonomous robots performing pose control

2. ARROW: Attack Resiliency Framework

This project proposes a novel attack-resilient theory for the protection and control of cyber-physical systems. Cyber-physical systems (CPSs) can be defined as complex systems that exhibit in-depth collaboration of computation, communications, and control, known as the 3C technology. We study self-driving platoons of autonomous vehicles and construct novel control methods to reject and recover from denial-of-service, false data injection, and replay attacks.
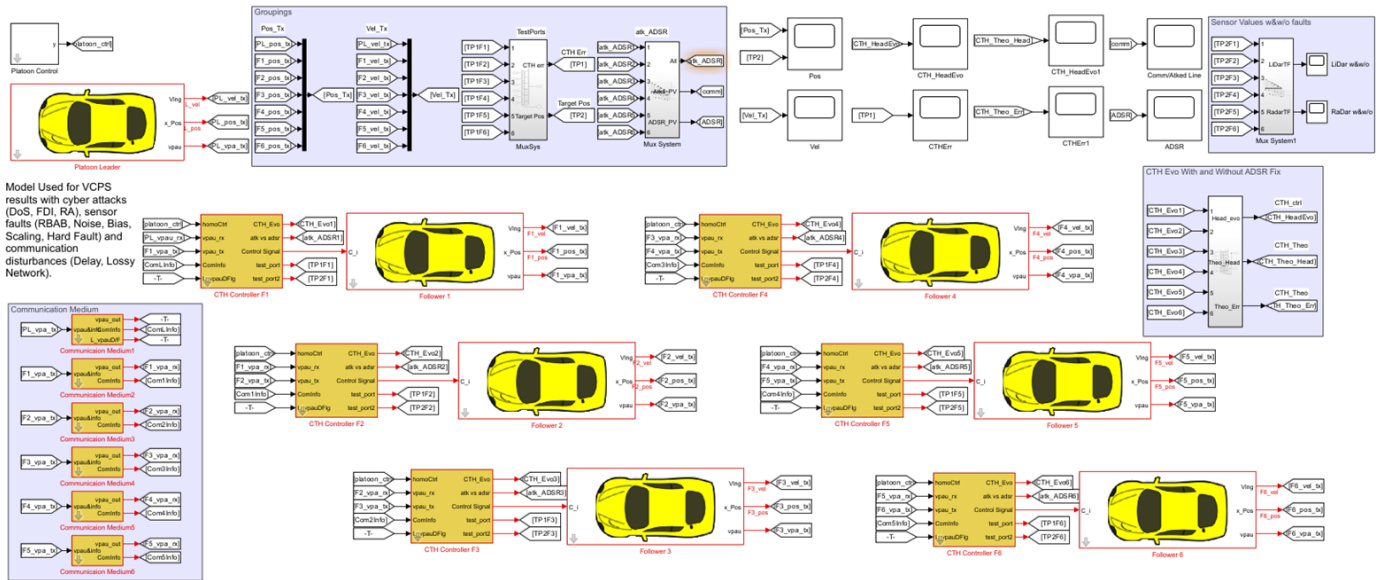

Figure 2: 7 Vehicle Autonomous Platoon in leader-follower configuration

1.ARDEN: Advanced Reasoning and Decision Networks

This project deals with the development of capable, scalable, multi-domain, multi-modal Neural Network models that retain low computational overhead during inference, the investigation into compressing knowledge representations and constructing theoretical guarantees for closed-loop stability and performance of advanced decision systems in closed-loop settings. This project serves as the theoretical foundation to the NANO project cluster.

2.QUILT: Multi-Agent Cooperative Transportation Control of a Quadrotor Lifting System

Quadrotor Unmanned Aerial Vehicles (QUAVs) are popular platforms for tethered payload transportation due to their agility, ability to hover precisely, and Vertical Take-Off and Landing (VTOL) capabilities. These vehicles, however, are limited by their carrying capability and require several smaller QUAVs that have a greater carrying capacity but are difficult to control and are prone to inter-agent collision and position error. This project aims to develop and implement an adaptive formation controller and individual agent controllers for the real-time adjustment of UAV load distribution, and minimization of the tethered payloads swing for a Multi-Agent UAV Lifting System.
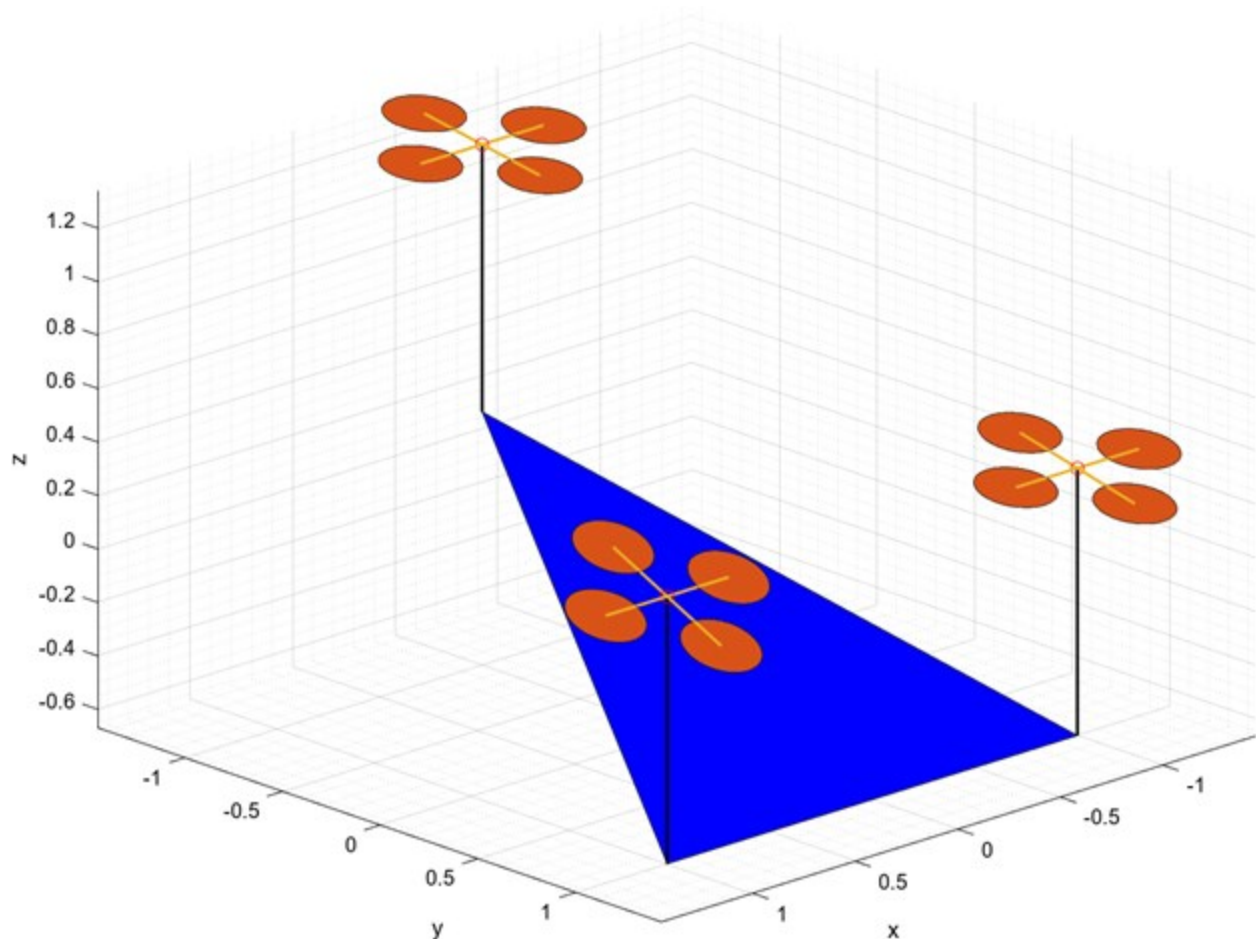

Figure 3: 3 Drone Autonomous Lifting System

ISL Project Clusters

1.NANO

ISL NANO is a project cluster aimed at developing and integrating systems that address core challenges in artificial intelligence research. It focuses on constructing scalable, capable, low-compute architectures that ensure robust performance across varying hardware configurations while maintaining alignment, transparency, and risk-awareness in AI applications. The scope of NANO comprises novel mathematical, software and hardware frameworks and is currently comprised of the following 6 projects:

CORTEX: A training and cross-platform inference framework for low-compute AI Systems.

This software framework is intended to be a training and cross-platform inference framework for AI systems primarily for low-compute devices optimized to share loads between the CPU and GPU.

SAFETY: A Quantitative Risk and Knowledge Distillation Framework for AI systems.

ISL-NANO Safety aims to develop a quantitative risk reduction framework and knowledge distillation software platform for automated fine-tuning to produce resilient and aligned AI systems.

SYMBOLICA: An argumentation and game theoretic framework for multi-agent AI systems

ISL-NANO Symbolica explores the development of faithful AI Agent systems with enhanced reasoning capabilities, by creating novel and using argumentation and game theories.

INSIGHT: A Universal Knowledge System for AI Memory Management

This project aims to develop a universal fault-tolerant data and knowledge orchestration system that is interoperable among various data sources and has a low level of reasoning.

EMBEDDED: Hardware Accelerators for NANO Machine Learning Architectures

This project aims to develop processing hardware accelerators for the list of compatible NANO machine-learning architectures.

AUTOMATON: The Autonomous Multimodal Planning, Decision and Reasoning System

This project explores the implementation of a control theoretical framework that allows the ability to integrate multi-domain multi-modal reasoning and planning machines with actuators and sensors to execute complex tasks. This project heavily focuses on the framework for integrating and learning new hardware and software tools to be operated as actuators and sensors in an autonomous system.
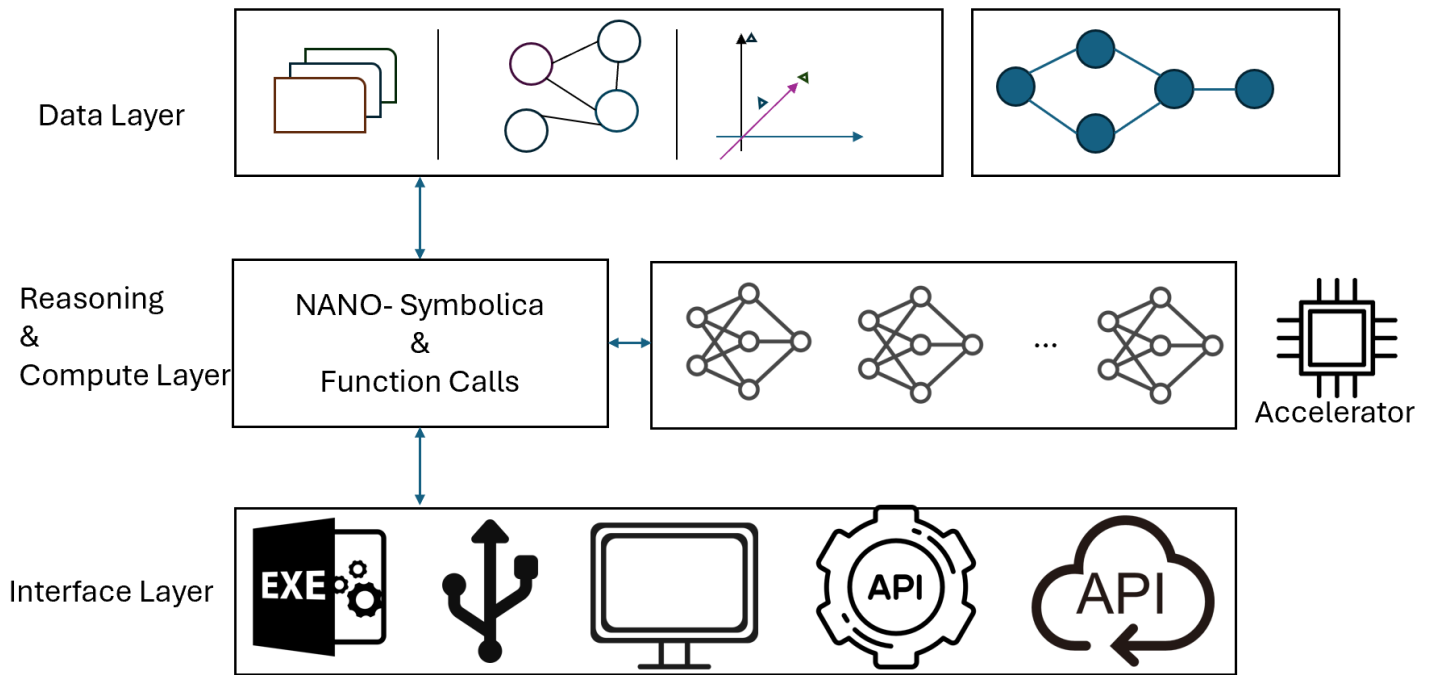
Figure 4: ISL-NANO System Architecture

2.PLASMA

Cold Atmospheric Plasma (CAP) is an emerging technology where gases are ionized at room temperature making it suitable for applications involving sensitive materials and living tissues. CAP is used to enhance seed germination, stimulate plant growth, and control pests and diseases. It has shown promise in wound healing, cancer treatment, and sterilization of medical equipment. It is used for decontamination of food products extending shelf life, improving food quality, degrading pollutants and inactivating pathogens in water and air. However, despite its potential, CAP technology faces challenges that limit its widespread adoption, especially in terms of precisely controlling plasma discharge and reactive species generation and variability in CAP composition and effects depending on gas type, device design, and environmental conditions.

This project cluster aims to develop intelligent plasma systems that treat with sensing and estimation of the reactive species generated by the CAP process. Prediction of plasma dynamics and control over the plasma discharge. In this phase of the project cluster, ISL-PLASMA is constructed of the following 2 projects:

HV-HF: High Voltage-High Frequency Controllable Power System

This project deals with the construction of a high-voltage power supply for a plasma generator with power and frequency characteristics specific to water treatment.

### NO2/3: Generating Soluble Nitrates from Atmospheric Air

This project deals with the design and implementation of electrode topologies for cold atmospheric plasma generation and a liquid delivery system for the creation of soluble nitrites/nitrates from atmospheric air.

Cluster Spotlight: ISL-PLASMA

Inputs: Electrical Energy, Water, Air

Process: Nitrification of untreated tap water using ISL's low-powered cold atmospheric plasma system. Solution plasma process allowed for 13min in air resulting in measurable nitrate/nitrite concentration increase.

Applications: Fertigation Management, Water Treatment,
             Chemical Production
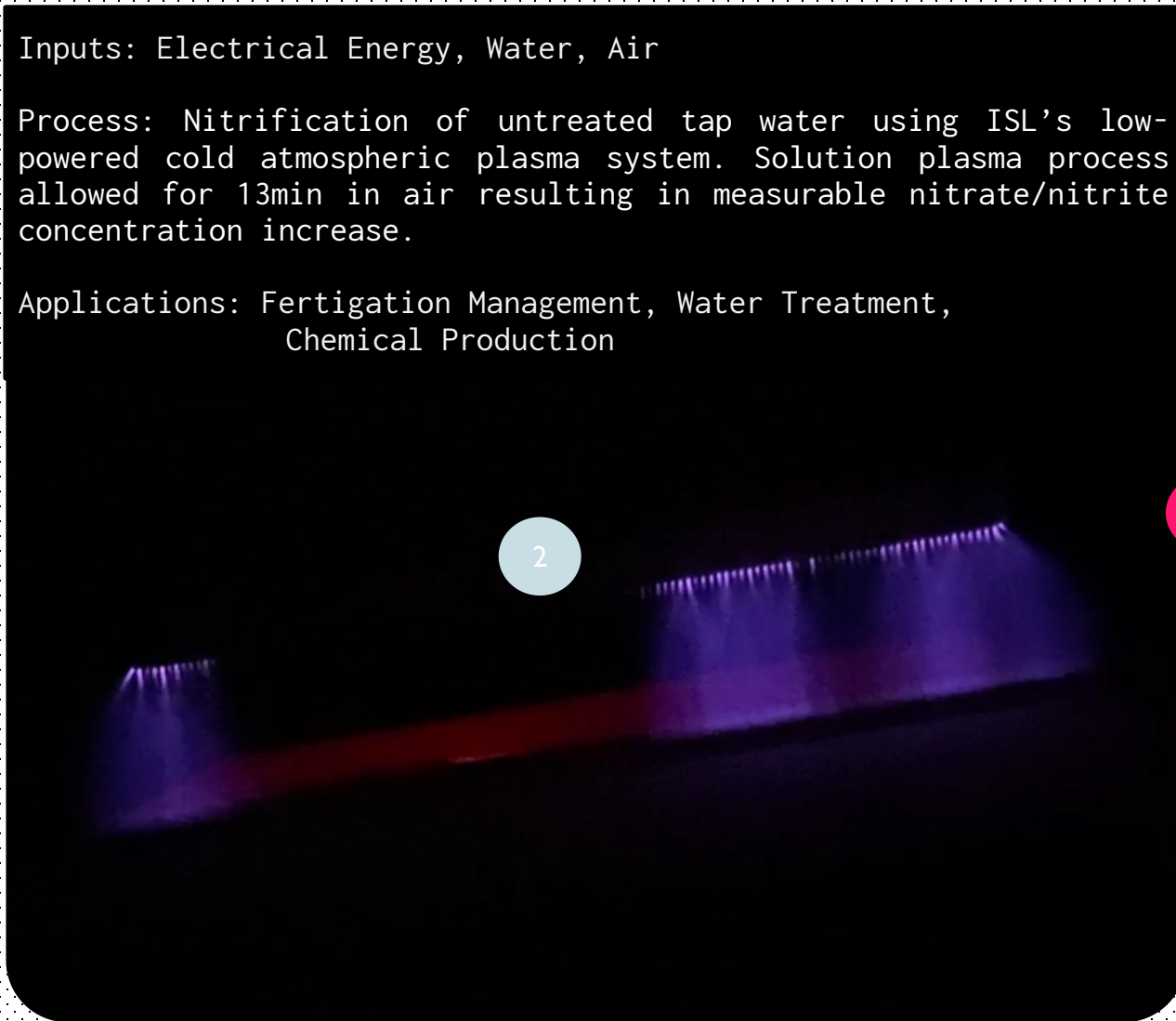
1	Nitrate/nitrite concentration in solution before plasma-liquid interaction
2	Direct cold atmospheric plasma exposure to untreated tap-water
3	Nitrate/nitrite concentration in solution after plasma activation

3. STAGE

The preservation of culture in an increasingly globalized world is a critical concern. While traditional methods like museums and archives play a vital role, these traditional methods often lack the adaptability to keep pace with shifting social and technological landscapes. Critical aspects of literary and oral traditions risk being overlooked or lost over time, and bridging cultural and educational gaps remains a concern where linguistic diversity and resource constraints limit equitable access. Moreover, there is a need to ensure ethical use of AI in safeguarding community rights and intellectual ownership. These issues underscore the urgency of AI-driven solutions that enable dynamic translation, digitization, and interactive engagement with cultural materials, thereby widening the scope of preservation efforts.

The projects for ISL-STAGE are listed as follows:

NPC: Fictional Character Reconstruction from Limited Data

Fictional Characters based on historical stories are a popular medium for storytelling and preserving cultural heritage. However, the creation of fictional characters from limited data is a challenge and usually requires the analysis and input of secondary sources. This project develops AI-driven reasoning methods to reconstruct fictional characters that reflect cultural narratives.

INTERFACE: Real-time AI systems for audiovisual human-machine interaction

This project centers on developing techniques for low-compute, AI-driven conversions between audio, visual, and text modalities. A primary focus is on enabling rapid speech-to-text transcription, text-to-speech synthesis, and intelligent character animation, all in real-time.

IMMERSIVE: VR Environment Simulation and Management

ISL-STAGE IMMERSIVE aims to create scalable workflows for designing and maintaining interactive 3D spaces rooted in cultural artifacts and historical reconstructions. The project uses digitized objects, landscapes, and architectural elements to generate authentic virtual environments that serve as a platform for educational exploration and experiential storytelling.

STORYCRAFT: Generative Narrative Authoring

This project is dedicated to automating the creation of branching narratives that incorporate cultural themes, character arcs, and user-defined story elements. The ultimate goal is to produce narratives that highlight regional stories and oral traditions while appealing to contemporary audiences and may include new interpretations or modernized retellings.

3.AMoS: Autonomous Mono- or Multi-Systems

ISL's Autonomous Mono- or Multi-Systems (AMoS) project cluster aims to develop decision theories applicable to both single and multiple interacting systems. AMoS is intended to be the theoretical backbone supporting estimation, predictive modeling, diagnostics, and control. This cluster includes activities to develop new theories, as well as generalize and adopt those from other ISL research projects. These theories are then streamlined into a standardized software framework that will subsequently drive implementations for other ISL project clusters and special projects. The projects for ISL-AMoS are listed follows:

NRAG: Nonlinear Robust-Adaptive Geometric Cooperative Control

In controlling high order robotic systems local parametrization, such as Euler angles, and quaternions cause singularities and representation ambiguities, respectively which constrains the angular range of motion of the system. For this reason, this project proposed modelling and controlling the system directly on its nonlinear manifold increasing the range of system operation.

T2ASMO: Attack Resilient Type-2 Fuzzy Sliding Mode Control

There is a growing need to design resilient control strategies to address the issue of cyberattacks for cyber-physical and robotic systems. This method implements a distributed multiagent expert technique based on event-triggered consensus attack-detection and identification, signal reconstruction and robust control.

OPTIMA: Decentralized Model Free Optimal Control

A decentralized motion control system for any multi-robot object manipulation task is proposed. This is achieved by minimizing the relative velocity between the robots and the object while satisfying kinematic constraints.

PROTON: Intelligent Subspace-Projection Based Adaptive Control for High-Order Nonlinear Systems

A recursive projection-based model-order reduction (MoR) technique and control algorithm is proposed for Lipschitzian nonlinear discrete-time-varying and discrete-time-invariant systems. The MoR technique preserves stability and recursively calculates the optimal local subspace projection matrix to reduce the approximation error. Inverting this reduced system forms an optimal controller.

ISL Special Projects

1.Advancing Water Quality through Blockchain Technology.

Overview:

Description: The Caribbean region faces critical water management challenges stemming from climate change impacts, infrastructure inefficiencies, and increasing demand across domestic, agricultural, and industrial sectors. This project studies the potential of blockchain technology to transform water management practices in the region by enhancing transparency, accountability, and efficiency. We propose *Aquachain*, a blockchain-based system leveraging Solana's scalable and cost-effective infrastructure to implement our water tariff structures which leverage real-time monitoring and tokenized transactions.

ISL Project Reference: ISL-BC-24
Institutions: Intelligent Systems Lab and the Global Water Partnership-Caribbean
Project Dependencies: None
Start Date: 01-03-2024   End Date:01-12-2024
Status: Closed

Outputs:
- Blockchain Technology Workshop 28/03/2024
- Submitted journal article: Blockchain Mechanisms for Sustainable Water Practices in the Caribbean Region
- Github code and project location: https://github.com/intelligent-systems-lab-org/AquaChain

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2.CSTAR: Caribbean Smart Teaching with AI Resources

Overview:

Description: CSTAR is a targeted initiative, created to address the educational and infrastructural realities of the Caribbean region. It recognizes the widespread challenges—such as limited access to high-performance computing resources and inconsistent internet connectivity—and aims to deliver smart teaching tools and applications that can operate on low-compute platforms. In the current offering, CSTAR is built for selected CSEC subjects.

ISL Project Reference: ISL-CX-24
Project Dependencies: ISL NANO-INSIGHT, ISL NANO-SAFETY, ISL NANO-SYMBOLICA
Start Date: 01-07-2024   End Date: N/A
Status: ongoing

Outputs:
- N/A

3. Airborne Light Matrix

Overview:

Description: Firework explosions release particulate matter into the atmosphere, creating chemical hazards that harm plants and animals. The loud blasts and sustained noise also affect both wildlife and nearby human communities. To address these issues, drone light shows were introduced, launching hundreds or even thousands of drones in designated flight zones. However, these shows have high upfront and maintenance costs, and their duration is limited by battery capacity.

This project aims to develop a cooperative drone system capable of lifting a large light grid, with power supplied via a tether from the ground. This approach can reduce costs and provide an alternative spectacle for festivals.

ISL Project Reference: ISL-AM-24
Project Dependencies: ISL AMoS-NRAG, ISL REPR-QUILT
Start Date: 01-07-2024   End Date: N/A
Status: ongoing

Outputs:
- N/A

4.Semi-automated restoration of cultural footage

Overview:

Description: Video is one of the most important cultural carriers. Traditionally, video has been stored on film, however, as a storage medium, film can naturally degrade through the deterioration of colour dyes over time and with dust causing scratches on the film thereby impacting the quality of the video.

ISL Project Reference: ISL-SR-24
Project Dependencies: ISL NANO-CORTEX, ISL NANO-SAFETY
Start Date: 01-09-2024   End Date: N/A
Status: ongoing

Outputs:
- N/A

4.Trinidadian Creole Speech Recognition

Overview:

Description: Speech recognition technology is becoming more widely adopted across services such as speech-to-text transcription and voice recognition. Additionally, integration with applications including emergency response centers and search engines makes it a valuable tool for interacting with computers.

ISL Project Reference: ISL-SR-24
Project Dependencies: ISL NANO-CORTEX
Start Date: 01-09-2024   End Date: N/A

Status: ongoing
Outputs:
- N/A

5.SimuNEX

Overview:
Description: SimuNEX is a cutting-edge high-fidelity dynamic simulation framework designed as a modular platform to simulate dynamic systems across various domains offering a versatile environment for simulating complex systems and phenomena.

ISL Project Reference: ISL-SX-22
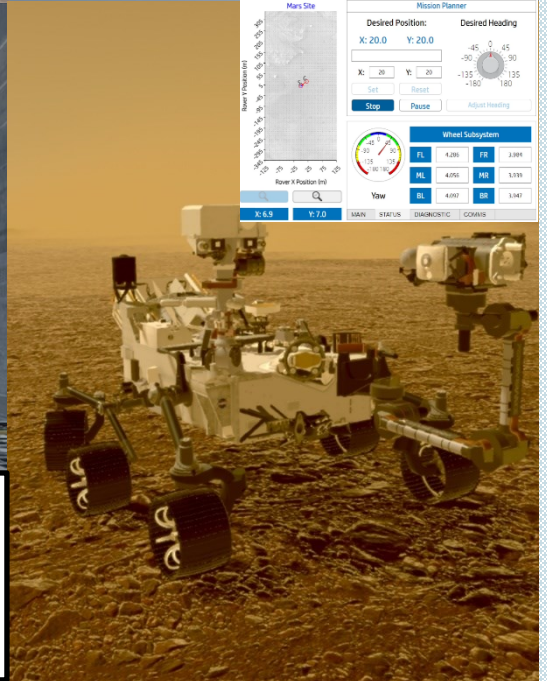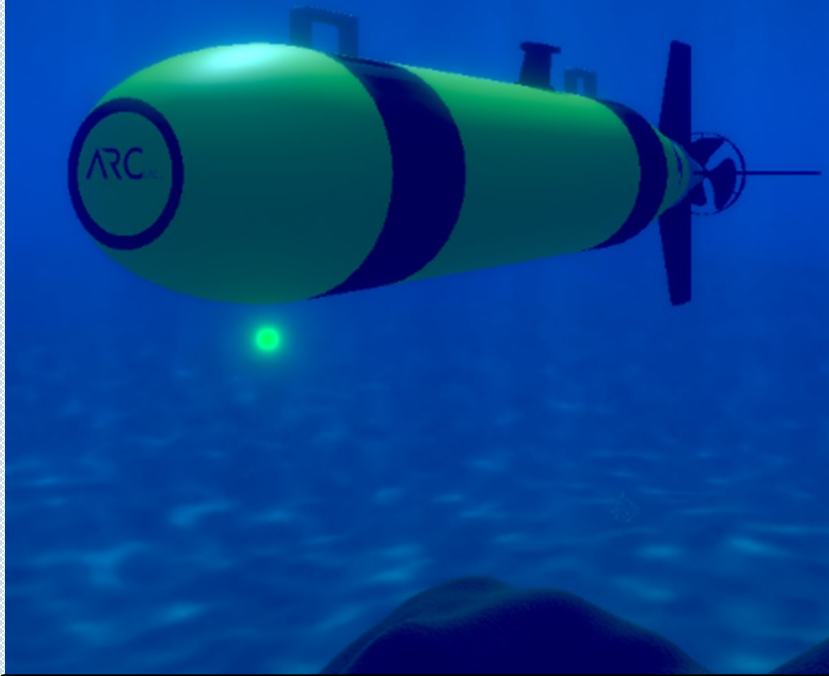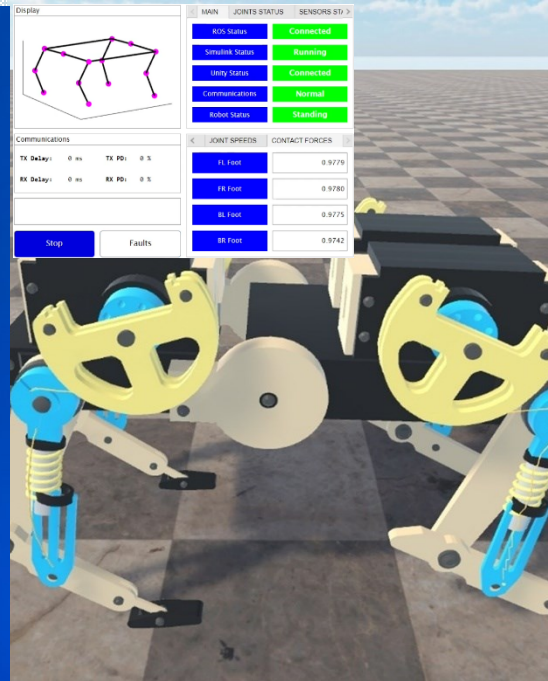Project Dependencies: None
Start Date: 01-07-2022   End Date: N/A
Status: ongoing

Outputs:
- Github link: https://github.com/intelligent-systems-lab-org/SimuNEX
- Submitted journal: SimuNEX: A 3D Simulation Framework for Teaching Control Systems

Special Project Spotlight: ISL SX-22 SimuNEX

SimuNEX is a high-fidelity simulation framework designed to facilitate the development of robotic systems, research in control systems, diagnose issues of industrial systems via digital twins and act as a training of teaching and learning of controls engineering in a safe, engaging, and cost-effective manner. SimuNEX is built using MATLAB, ROS-2 and Unity.

The way forward

This year the ISL has demonstrated significant progress in advancing both fundamental research and practical applications in intelligent systems. Its expansion to 24 active researchers has diversified perspectives and expertise and has strengthened our capacity for multidisciplinary research.

Looking ahead, the year 2025 promises to be pivotal in scaling these successes. Central to our vision is a commitment to deepening collaborations, recognizing that impact can only be achieved through collective effort. In the coming year, we aim to tackle capacity-building initiatives, secure funding, implementation and incubation of ISL's cutting edge technologies, conduct studies for evidence-based policy creation and focus on branding and awareness of the lab and its projects to amplify our reach.

INTELLIGENT
SYSTEMS LAB
Impact through Systems Learning