**CCNY College-wide Research Vision (CRV) Initiative Concept White Paper**

# Convergence Research for an Inclusive City

**Project Team:**


| Principal Investigators | Departments |
|---|---|
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**Other Key Personnel**

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**Project Concept Description:**

**Keywords**: cybernetic urbanism, climate adaptation, environmental justice, urban ecology

**Objective: An Inclusive City for All**

As we witness the accumulating effects of the climate crisis and social injustice in urban spaces, the reconceptualization of cities – our largest and most complex technological systems – is needed now. To foster cities that serve all, this research initiative – ***Convergence Research for an Inclusive City*** – envisions a dynamic platform for converging research between urban design and intelligent analytics to harness the digital enlightenment of the century. Led by a core partnership between the Spitzer School of Architecture and the Grove School of Engineering, this project aims to merge expertise throughout the City College community and invent new concepts, frameworks, and strategies to reimagine the urban future. To embrace the multi-faceted nature of "inclusivity," the research program has identified three principles. An urban future should be inclusive to (1) ***diverse communities and groups*** – race, gender, physical and mental abilities, etc.; (2) ***urban wildlife and ecological forces*** contributing to cities' adaptivity; and (3) ***different expertise, perspectives, and frameworks*** for cities.

**Approach: Beyond Smart Cities**

This project looks beyond smart cities, a *paradigm that often reinforces unjust and nonadaptive urban spaces by extending outdated frameworks*. "Smart cities" practice has been optimized as an engineering problem while being critiqued as a sociotechnical phenomenon over the past decade. Now is the time to close the gap between skepticism and technology enthusiasm, think beyond optimization and control, and collaborate to explore the true potential of "**cybernetic urbanism.**" This initiative harnesses the *technological breakthroughs* in artificial intelligence (AI), the internet of things (IoT), data science & engineering and the *critical frameworks* in urban design and humanities to challenge the status quo and re-envision a new city paradigm for all. With the aim to coalesce expertise across school boundaries at CCNY and beyond, this project identifies three research thrusts: (1) ***A holistic approach*** *of bio-cyber-physical urban ecosystems with synergistic relations between all players.* This initiative re-envisions AI, IoTs, machine learning as integral parts in the bio-cyber-physical systems, interacting with human and nonhuman inhabitants, rather than a cyber layer of control mechanism added to cities. (2) ***An integrative approach*** *of enhanced design and analysis feedback loops.* The research Integrates sensing and data analytics with urban and landscape design, which, in turn, informs new analytical strategies. "Design" is, thus, detached from short-term outcomes and becomes a long-term learning and adapting process. (3) ***A convergent approach*** *of a multi-faceted, inclusive-cities paradigm.* We embrace multiple dimensions of inclusivity and convergence of diverse communities, heterogeneous ecological forces and a wide spectrum of expertise and perspectives. We will generate real-world impact by merging diverse communities and partners through pilot projects.

We have identified three grand challenges for today's cities: ***1) urban ecosystem and resilience, 2) climate and disaster adaptation, and 3) urban accessibility.*** These three interrelated areas will be addressed by three pilot projects with overlapping investigators and partners. The goal is to identify a common thread and propose a holistic framework in understanding urban environments as bio-cyber-physical systems.

**Outcome: A New Conceptual Framework**

Fundamental contributions involve ***theoretical advancement*** for urban and landscape research to study cities as complex, socio-technological systems, and **novel *design-analysis methodologies*** for both engineering and design, including new tools, methods, and principles. Together they serve as ***a new conceptual framework*** with transformative theories and methods for a new paradigm – an inclusive city for all. Expected Tangible Products include: (1) **A colloquium series** followed by **an anthology** contributed by the team members, community partners, and invited scholars. (2) **A whitepaper** targeting **NSF** such as the DCL for "Innovative Solutions to Climate Change" and **a proposal** to NSF Science and Technology Center (STC) and/or Engineering Research Center (ERC) programs to establish an **Inclusive-City Institute.** This new institute will strengthen our decade-long collaborations with partner institutions, such as Rutgers, NYU and Columbia. (3) **Joint publications, conference panels, and exhibitions** in the convergence of design and AI. Zhang has published widely on computational design and serves as a committee member for the Digital Landscape Architecture conference. Zhu and Vo have been working on a Smart and Accessible Transportation Hub (SAT-Hub) project and published on large-scale facility analysis, visualization and assistive navigation for people with disabilities. The spin-off company of his team Nearabl develops various assistive navigation applications. Other team members (Allahviranloo, Vo, Nordenson) have widely published on related topics, including new transportation technologies and travel behavior, landscape strategies for coastal adaptation, and social aspects of big data. This proposed collaboration will initiate new research avenues for multiple major publications, exhibitions, and presentations.

**Merit: Supra-disciplinary**

The novelty of this project lies in the synergistic integration of three pillars: ***technology development*** for cities and communities, ***urban and landscape research*** to address issues of social equity, ecological integrity, and climate adaptation, and ***design research*** to synthesize multiple dimensions and perspectives. This research will become a dynamic platform to coalesce expertise across the CCNY and beyond with a transdisciplinary framework. The pilot projects are deeply related to and will inform each other to reimagine an inclusive city paradigm with overlapping investigators and community partners.

**Impact: New York City as a Prototype**

Unlike many "urban labs" that treat the city as a "testing ground" and its communities as "testing subjects", this research involves diverse partners from the conceptual stage and aims to produce real-world changes. Our team members have already built trusted relationships with partners from the public and private sectors such as Smart Cities + IoT Lab of NYC MOCTO, NYC MOPD, PANYNJ, NJ Transit, Lighthouse Guild, Goodwill NYNJ, the Met, NOAA-CREST, NYCDOT, NYMTC, Jones Beach Energy & Nature Center, etc. Our initiative has also generated enthusiasm and support from many CUNY scholars. All pilot projects will involve community partners in the NYC region and serve as catalysts to bring different perspectives and expertise together. After the three-year funding, the team will build enough research capacity to seek funding for an Inclusive-Cities Institute that applies the innovative conceptual frameworks in real-world problems beyond New York City.

**Milestones:**

**Year One (2022-2023): Inclusive City Pilots**

**Summer 2022: Kick-off and brainstorming.** (1) Hold a one-day workshop with community partners and identify key concerns that drive the research focus of the pilot projects. (2) Initialize integrative Pilot Projects with community partners.

**Fall 2022: Design pilot projects.** Host weekly colloquiums with research updates and build a research network through project development. The weekly public event will enhance integrative research relevance to coalesce additional experts across CUNY and build an active network to strengthen the research capacity.

**Spring 2023: Implement pilot projects**. Continue biweekly colloquiums to get feedback from the research network.

**Year Two (2023-2024): Inclusive City Prototype**

**Summer 2023: Mid-term review.** Hold a one-day workshop with community partners, present pilot project mid-term outcomes and gather feedback.

**Fall 2023: Develop a conceptual framework.** Identify the common thread in the pilot projects and develop a conceptual framework for an Inclusive City Prototype, including new concepts, theoretical frameworks, and design strategies.

**Spring 2024: Evaluate new tools and methods.** Develop new tools, software, models, and simulations for an enhanced design-analysis feedback loop. Test these new methods with pilot projects.

**Year Three (2024-2025): Inclusive City Symposium**

**Summer 2024: Symposium.** Hold a two-day symposium + exhibition with invited guest speakers and community partners and present pilot project outcomes, the conceptual framework, and methods.

**Fall 2024: Develop a book proposal and a whitepaper.** (1) Synthesis research outcomes and submit a book proposal. The book will be co-edited by the PIs and contributed by the project team members, guest speakers, and community partners. (2) Develop a whitepaper targeting external funding agencies.

**Spring 2025: Conclude the research.** (1) Finish the book project with the authors. (2) Submit a joint grant proposal to external funding agencies. (3) Develop a joint proposal for an **Inclusive-Cities Institute** and submit it to the NSF Planning Grants for Science and Technology Center (STC) and/or Engineering Research Center (ERC).

**Year Four to Ten (2025-2030): Research legacy**

Seek funding and opportunities to establish the **Inclusive Cities Institute (ICI)** conducting integrative research projects. The ICI will keep developing new concepts, theoretical frameworks, methodologies, and tools for the next cities. It will serve as an innovation hub to keep building partners and research networks beyond New York City.

**Budget (Maximum Budget $200K):**

The CRV grant will support convergent research on bridging the gap between the breakthroughs in AI, IoT, machine learning, data science & engineering, and critical frameworks in design and humanities, to create a new research direction that harnesses the technology development for an inclusive city paradigm. The outcome of the funded research will evolve into a multidisciplinary institute within seven to ten years.

Personnel Costs: (yearly budget including fringe total $220,000)

- Key Personnel (PI, Co-PI, senior personnel)
  - PIs (Zhang and Zhu): $10,000 x 2 for summer salaries of two PIs in leading the projects and doing joint convergence research in design and analytics
  - Co-PIs (Allahviranloo, Nordenson, Vo): $5,000x3 for summer salaries for the three Co-PIs for doing joint convergence research in engineering, visualization and urban ecology
  - SPs (TBD, 4): $3,000x4 for summer salaries of additional researchers involved in the projects (first year for distributing to the two PIs and three Co-PIs)
- Research staff: PostDoc (50%): $50,000 (see below)
- Administration staff: Project Manager (50%): $30,000 (one person for both PostDoc and manager, with 50% workload for each role.)
- Students:
  - PhD: $20,000x3 (each student 60% support, for three students, in computer science, civil engineering and school of architecture. This can support an interdisciplinary PhD co-advised by faculties from two schools.)
  - MS: $8,000x3 (three students in the Data Science and Engineering (DSE) program and School of Architecture)
  - Undergrad: $3,000x3 (three students in CS, CpE and School of Architecture)