

# *Austringer*

An interdisciplinary performance piece by Louisa Pancoast and Dr. Nialah Wilson-Small  
Artists-In-Residence with  
Smashworks Dance, a 501c3 non-profit organization

Estimated timeline: Spring 2025  
Estimated budget (inclusive of all human labor): \$62,000

## **Project Synopsis**

*Austringer* is an immersive contemporary dance piece with a network of multiple drone dancers, four human dancers, and one drone pilot, exploring physical contact and proximity and how they relate to surveillance and intimacy. A now obsolete term referring to a keeper of goshawks (equivalent to a falconer), *austringer* encompasses the complex dynamic amongst a team of predators: one airborne and the other earthbound. Human and drone dancers will partner with one another using physical contact and weight sharing, shared autonomy, and a mix of improvised and choreographed movement to question how our notion of privacy is altered by intimate encounters with data-collecting robotic bodies.



## **Project Description**

*Austringer* is inspired by the ubiquity of data-collecting, surveillant devices in our homes and on our bodies, as well as the nature of drones, themselves. Automated vacuum cleaners, wearable fitness trackers, and home security devices map the blueprints of our shelters, collect data about our pulse, REM cycle, and exertion, and monitor our location in and outside our homes. We willfully invite them to amass information about our houses and our bodies, and quickly assimilate their presence into our daily lives. Unlike our watches, bands, and Roombas, drones have a polarized identity in our collective imagination; they are weapons of mass destruction, or they are harmless, pet-like toys treated like remote-control airplanes. Regardless of either identity, there is a common denominator in our understanding of drones: they are distant from us. Their flight makes them unequivocally alien, whether in our backyards or above foreign terrain. *Austringer* not only brings drones and dancers into the same pictorial plane, but it shows physical contact, weight sharing, and intimacy between these bodies, as well. We ask: how does human perception change as the distance between the surveillant and the surveilled changes; how do physical intimacy and surveillance coexist; and what impact do they have on one another?

Per the relationship between a goshawk and its austringer, there is a symbiosis between our choreographic innovations and technological innovations. Both aspects will be developed concurrently. *Austringer* is predicated on the premise that the humans and drones participate in an equitable artistic partnership; both have autonomy and both are considered dancers. This premise presents movement and engineering challenges, including choreographing for a non-human body and creating load-bearing, autonomous drones.

### *Performance Narrative:*

*Austringer* includes set choreography for both the humans and drones, allowing them to dance together as a group, in drone-human duets, and as separate groups. The performance will begin with the drones hovering over the dancers and the audience, including the audience in the sensation of being watched, and subjecting them to the noise and breeze generated by the drones' propellers. Throughout the course of the performance, the drones will come increasingly closer and embed themselves amongst the dancers and the audience.

The drones will initially follow the basic movement pathways of the dancers, responding to the dancers' choreography with their bodies in the air. As the drones approach the dancers, their choreography becomes further individualized, suggesting a level of learning and autonomy as they gather data from below. [During our previous research](#), we developed algorithms for drone behaviors that enabled partnership between a drone and a dancer; we will continue with this research.

The centerpiece of *Austringer* will be a collection of dancer-drone duets. This sequence will be driven by Contact Improvisation between the drones and the dancers. As the piece progresses,

both the drones and dancers will dissipate from the performance space. One drone will always remain hovering directly above the front edge of the stage and will not shift position. Ultimately, only two drones and one dancer will remain, culminating in a choreographed partnering-based duet between the human and one of the drones; the second drone will continue to hover above.

Much of the movement vocabulary for *Austringer* will be created from data gathered during the research portion of Dr. Wilson-Small's and my work together. While developing force profiles for our instances of physical human-drone contact, we generated graphs that tracked the amount of physical force imposed on the drone. These graphs will serve as movement maps, becoming pathways through the space and inspiring arcs, curves, and peaks inscribed by the dancers' bodies. Other movement vocabularies will be inspired by terrain photos taken from reconnaissance drones. All of the drones will be outfitted with cameras and acceleration trackers attached to a live feed, and touch-sensitive encasements. A projection shifting between the drones' camera feeds and their acceleration trackers will be visible on the scrim or wall behind the dancers at all times.

#### *Technical Development:*

To realize our performance, we will develop technologies in the three areas:

1. Enhanced safe-to-touch drone enclosure designs.
2. New ways for drones to communicate with humans via touch.
3. New data available due to the closeness of the human-drone interaction (force charts, images).

*Enhanced safe-to-touch drone enclosures*, or SmartCages, as we call them, are necessary to fully realize a physically interactive performance. The SmartCages include cameras, IMUs, and touch sensors so the drone can have a complete understanding of the force it is imparting to the human at all times. The shape, texture, form factor, color, and aerodynamics of the SmartCage must be carefully considered to maximize utility while minimizing weight and enhancing a human's ability/desire to engage with the drone physically. No such cage design has considered all of these factors before, and this work will allow us to develop a prototype which can be used by researchers to further study physical human drone interactions more broadly.

To develop *new ways for drones to communicate with humans via touch* we focus on interaction design and algorithm development. Touch is important in human-human interactions and has been researched thoroughly in traditional human robot interactions. However, there are more unanswered questions surrounding how drones can use touch to enhance communication with humans. In our previous works, we conducted exploratory research to understand how people respond to drone touch [1], how they interpret drone touch communications [2], and how they use these responses and interpretations to collaborate with the drone [3]. Our goal now is to build on this research to expand the possibilities for human-drone collaborations in load-bearing and

other useful work tasks. To do this we will use information from the human dancers' experiences partnering with the drones, and develop algorithms that allow the drone to modify its movements in response to certain human cues.

Due to the sensors we use in our SmartCage and the closeness of the human-drone interaction, we found that we have *access to a rich set of personal data not previously available in traditional human robot interactions*. The drone can acquire images and videos from several unique angles within the intimate space. Additionally, the force sensors used to accomplish weight sharing and improve the physical contact between the human and drone allow us to create a complete force profile of the human over time. These inform our questions around privacy and intimate encounters. With these unique angles and force profiles, we explore what unwanted information can be reconstructed about the human using AI or more rudimentary techniques. It also leads to questions of who has a right to this new data, how can it ethically be stored, and what are the consequences if this information is compromised?

### **Relevance**

This technology development allows for:

1. New possibilities for collaboration between drones and humans for important tasks (workplace, search and rescue, etc.) (load-bearing)
2. New experiences for human dancers and audience members during performances.
3. Understanding human perceptions of drone surveillance and how this affects the trajectory of physical human drone interaction applications.

All of our work on stage with physical human-drone interactions helps us answer broader questions about how to develop drones that can be more effective tools to enhance people's daily lives. Some example applications include crowd control, emergency evacuation situations, independent exercise or therapy, and workplace human-robot collaboration. Some of these elements we have explored already in our published works. How does the shape, acceleration, force feedback, and surface texture of a drone impact how it supports a human, and how does a human react to these variables? Exploring these questions through the context of a dance partnership and Contact Improvisation allows us to find a wider, and less conventional array of answers to these questions, while incorporating the idea of variability. Our investigations surrounding the nuances and complexity of load-bearing drones will increase drones' ability to navigate a wide range of physical contact scenarios, while cultivating the trust of the humans they support.

*Austringer* also challenges the expectation that surveillance implies physical distance. How do we grapple with surveillance performed through physical contact? By bringing drones into our performance and incorporating them as dance partners, we merge imaginative, distant spaces with real, proximal ones. Physical contact disrupts the stark distinction between drone as toy and

drone as data-scavenging weapons of mass destruction, creating dissonance in the audience's categorical understanding of these machines. The audience is not only asked to watch the drones collect data in real time, but witness the dancers forge a physically intimate relationship with the drones as they're collecting data, as well. The audience must reconcile the presence of drones in our daily lives, rather than relegate them to the distant, narrative space of news and media. We challenge the audience to question their willingness to submit to constant surveillance when the surveillant is distant, and how physical contact affects their comfortability.

### **Project Origination/History**

Dr. Wilson-Small's and my collaboration began in the context of her doctoral thesis, considering how an exploration of Contact Improvisation between a drone and a human could offer insight into touch-based instruction. We developed a force profile and a coded movement vocabulary for the drone, based on the principles of Contact Improvisation and characteristics of a strong dance partnership. We then set up a blind experiment in which the drone operated at different levels of autonomy, or ratios of it making movement decisions of its own accord or responding to my (the dancer's) physical touch. This research was supported by Cornell Tech's /Art Microgrant. Since completing the experiment, we have used our drone-human partnership to begin to develop choreography and consider the "drone-ness" of drones. Most recently, our paper "Exploring Human-Drone Collaboration Through Contact Improvisation" was presented as a Late-Breaking Report by the ACM/IEEE International Conference on Human-Robot Interaction in March 2023 in Stockholm, Sweden.

### **Developmental Plan**

Currently the project has a choreographic storyboard, and the coding and partnering model developed in our initial Contact Improvisation experiment with one drone and one human. During the experiment phase of our development, we amassed a library of footage of the drone dancer and human dancer moving individually and together. We have already reviewed this footage to cull out some salient images that we hope to recreate. During the experiment phase we also generated a graph demonstrating peaks and drops in the drone motor's force. This graph will be used both to recreate some of our improvised movements, and serve as a generative script in making new choreography.

Our needs moving forward lie both in choreographic and technological development. Please see the below table for an estimate of our upcoming costs:

<b>Item</b>	<b>Cost</b>
Dancer fee (inclusive of rehearsals + performances)	\$16,800 (160 hours, \$20/hr, \$1000/performance fee for 4 dancers)
Rehearsal space	\$4,000 (160 hours, \$25/hour rental)
Choreographer fee 1	\$5,000
Choreographer fee 2	\$5,000
Production costs (theatre rental, lighting, sound design)	\$10,000
Marketing	\$1,000
Insurance	\$770
Student Researcher	\$7,000
Drone development (hardware & software) [Microcontroller (NVIDIA), software (CAD, computers, etc., hardware (frame, sensors, fabrics, etc.)]	\$13,000
<b>Total</b>	<b>\$62,000</b>

To proceed with the project, we need to acquire and program four drones; we need to develop an algorithm to allow multiple drones to coordinate with one another, so as to create group choreography; and we need rehearsal space to develop a specific movement vocabulary for the piece. Additionally, we would like to use movement studies to develop a touch-sensitive case with haptic feedback for the drone, so as to enhance its drone-human partnering abilities. We plan to develop our tech and our movement concurrently, using the needs of both the human and drones to inform the shape of the piece's gestures.

We project a Spring 2025 premiere of *Austringer*.

### **Collaborator Bios**

**Louisa Pancoast** is a contemporary dance artist based in Brooklyn, New York. She is a graduate of the Certificate Program at Peridance, New York, NY, and was part of the inaugural group at the Barton Movement's Axis Connect. Louisa has had the privilege of performing for such choreographers as Yvonne Rainer, Diego Funes, Pat Catterson, Sommer Ulrickson and Alexander Polzin, Cleo Mack and Rock Dance Collective, Pramila Vasudevan, Ashley McQueen, Michelle Thompson-Ulerich, Emily Bufferd, Jacqueline Dugal, Monica Hogan, Yuki

Hasagawa, and Joyce King. Louisa has appeared in videos directed by The Kuperman Brothers and Gierre Godley; and has served as performer and movement director for rapper Lando Chill's music video, *Light Her* and Diego Funes' short film, *ABSENCE*. Louisa's choreography includes *Strange Girl Dances*, at Garvey|Simon, *HouseBroken* at -the gallery LTD-; *Pinch Back* at Main Window, *DUMBO*, *Are you not entertained?* at The Boiler, an adaptation of W.B. Yeats' play *Purgatory* produced by Plaxall Gallery, Long Island City, and *First in Half, Then in Quarters*, produced by Mixily Presents. She is also the Associate Director of De Funes Dance, and sits on the Development Board for Smashworks Dance. In addition to performing, Louisa holds her B.A. in English Literature and Art History from New York University. She is interested in finding the intersections between different mediums and modes of communication in all of her work.

**Nialah Wilson-Small, PhD**, is an Industry Assistant Professor at NYU in the Tandon School of Engineering. She teaches Mechatronics and other robotics courses in the Mechanical and Aerospace Engineering Department. Her research centers coordination algorithms for multi-robot systems and human-drone interactions. Specifically, she studies how drones can use tactile feedback to influence human motion. Her work is at the cross section of design, human-robot interaction, and autonomy. She earned my PhD in Aerospace Engineering from Cornell University where she became the first Black woman in the university's history to do so. She also earned an MS in Aerospace Engineering from Cornell and a BS in Mechanical Engineering from Howard University.

### **Smashworks Dance**

Smashworks Dance is a New York-based dance company founded and directed by choreographer Ashley McQueen. We dance to advocate for women's empowerment through performing arts, educational programming, and community outreach. We make dance accessible and inspire audiences to take action through our performances both onstage and in site-specific environments. We view artistic expression as power—smashing stereotypes and promoting dance as a unifying and confidence-building practice for all.