The Nonhuman Autonomous Space Agency

In the summer of 2011, the last Space Shuttle launch took place at Cape Canaveral, Florida. When the Shuttle landed 13 days later, the United States, for the first time in 30 years, no longer operated a vehicle capable of carrying humans into Low Earth Orbit.

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A few miles from Cape Canaveral, in places like Blue Springs State Park, Florida's endangered population of manatees takes shelter in the warm spring water that rises through the state's porous limestone geology. Manatees are famous for their somewhat goofy hybridity, which according to stories led some sailors to mistake them for the half human, half fish mermaids of legend. Like the Space Shuttle, itself a hybrid compromise between budgetary, political, and performance constraints, manatees become surprisingly graceful when they are embedded and active in the their environment. In ecological science, biologists talk about the concept of the 'charismatic megafauna'[1], a species of animal that is well known and well liked, which serves as a stand-in and focal point for the complexities of the ecosystem in which it lives. Polar bears serve as a good starting point for discussions about the effects of climate change. Talking about manatees is a way to begin to talk about how we use the landscape of Florida and the Caribbean recreationally, and how to possibly change some careless habits associated with that use.

MASCOTS AND MEGAFAUNA

With the absence of the Space Shuttle as a recognizable icon, the whole enterprise of space exploration now has a unique problem, it no longer has a mascot. The Space Shuttle Orbiter, which we usually call simply 'the shuttle', is just one component of a complex system that includes the complete launch stack with boosters and tank, the huge crawler that carries the stack to the launch tower, and the even more massive Vehicle Assembly Building, the largest single story structure in the world. This totality, for which the shuttle orbiter is a stand-in, is formally designated as STS, or 'Space Transportation System'[2], but the Shuttle is also the charismatic megafauna for outer space in general. The status of the Shuttle as a recognizable icon is so widespread that when other nations set out to create their own reusable spaceplanes, they often lift engineering and styling

details from the Shuttle design, or, in the case of the Soviet Buran, copy the form outright. The shuttle is so prominent in visual culture as the friendly and accessible mascot for outer space, that when the Air Force needed an unpiloted orbital drone with a Top Secret mission profile, the X-37B, they styled it to look like a blind baby robot space shuttle. Charismatic megafauna are more than simple condensations of complexity. We tend to easily recognize them as other subjectivities, other unique presences in the world. They have moods and character traits, and we have feelings about them in response.

1

The practice of adopting and recognizing mascots for outer space goes back to the beginning of space science. In 1957, Laika, a stray dog from Moscow, became the first animal in orbit. Her image, combined with a narrative of bravery and sacrifice, made her a national figure. She is almost always included in monuments recognizing the pioneers of early space exploration, especially within the former Soviet Union.[3] After Laika, whose mission was not designed to be survivable, the United States and the Soviet Union made several successful recoverable test flights with other dogs, monkeys, and even rabbits.

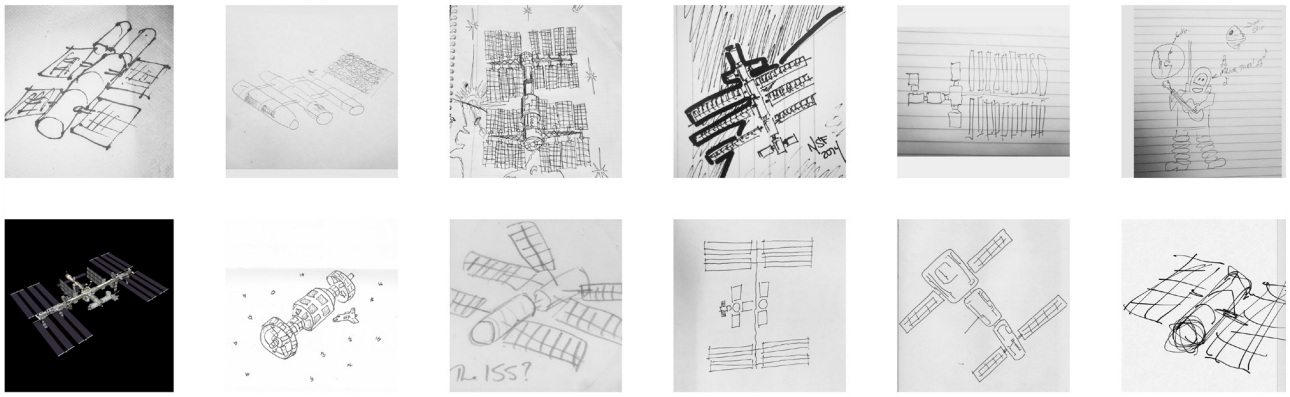
Since the decommissioning of the Shuttle fleet, the most prominent artifact in Earth orbit is the International Space Station. It is difficult, though, to ascribe any subjectivity to, or even to objectify, the ISS. The Shuttle is a closed figure, while the ISS is an open and edgeless network. Over the 16 year and counting period of its construction and existence, the ISS has changed configuration several times as older modules are moved around to make room for new ones. The station even changes its configuration over the course of each 90 minute orbit, shifting its solar panels and thermal radiators so that they stay in sunlight and shade, respectively.[4] Its status as a dynamic network of parts is constantly disrupting any attempts to figure it. While almost any child can sketch the Space Shuttle, an informal experiment, by the author in summer 2014, asking respondents on social media to draw the ISS from memory, showed that few people had a confident sense of its shape. Our sense of it is always being contaminated by other space ships and stations from fiction, from the future, or from the past. One respondent drew a picture of Commander Chris Hadfield, whose activity on social media, capped off by a cover of David Bowie's song Space Oddity,[5] has arguably done the most to raise awareness about the current status of human existence in orbit in the post-Shuttle era.

Figure 1: A collage showing various international Space Shuttle proposals, built and unbuilt. The Soviet Buran is on the lower left, and the US Air Force's Top Secret X-37B is on the upper right

NETWORKS OF OTHERS

In the early 2010s, NASA has tried a few different strategies to maintain the

combination of recognizability, emotional relationship, and subjectivity that a mascot invokes for the public; most of these involve networked conversations on social media. In August 2012 the Curiosity Rover successfully landed on Mars, and right away checked in on foursquare and began using twitter to post selfies among the panoramas and landscapes of Gale Crater.[6] When it first used its laser to take a sample of a local rock, someone even created a twitter account for the rock and tweeted back at the rover.[7] Since landing, Curiosity also regularly uses its twitter account to talk back and forth with NASA's other active Mars rover, Opportunity.[8]



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In a 1989 paper titled 'Fast, cheap, and Out of Control: A robot Invasion of the Solar System',[9] MIT roboticists Rodney Brooks and Anita Flynn argued for a new paradigm, embodied in that paper title, for space exploration. In Brooks and Flynns' scenario, swarms of robots, and even the components of the robots themselves, all act independently according to local priorities, communicating directly with one another as needed, and avoiding the expense and trouble of centralized command and control. The Curiosity Rover is not fast, cheap, or out of control, but if we imagine it working in coordinated ways with its parent missions, the Mars Science Laboratory, and the even broader meta-mission, the ten-year-and-counting Mars Exploration Program, we can start to see this as a miniature ecosystem. Along with the other operative spacecraft in the solar system, many of whom also have twitter accounts, this network starts to form something like a swarm of robots, as envisioned by Brooks and his co-author, all communicating via what NASA's Goddard Space Flight Center is calling 'The Interplanetary Internet'.[10]

If this swarm of robots is having a constant conversation with itself, what is it saying? In a talk for the 2014 foocamp conference, hosted by O'Reilly media, the inventor and technologist Tom Coates laid out a conversational protocol for this kind of inter-robot interaction, within the context of a next generation 'Internet of Things'.[11] Coates' house, along with several hotels, landmarks, and structures in danger of demolition, is one of only a few buildings with their own twitter account. His house speaks in the first person, updating followers about temperature, lights, and the movement of occupants. Coates is interested in using systems like this to make the conversation between pieces of software and hardware intelligible to the humans who use and participate in the network. He and his collaborators have outlined a framework, "to create a parallel space in which

Figure 2: ISS Drawing Collage, by various social media correspondents. A NASA rendering of the ISS is in the lower left, and a drawing of Commander Chris Hadfield is on the upper right

objects could speak in human-readable language. Much like a conference might have a chatroom, so might a home. And it might be a space that you could duck into as you pleased to see what was going on":

> Motion Sensor: You know, I think he's gone out. It's been quite a while
>
> Gatekeeper: I'll just send him a note and see ...
>
> Gatekeeper: Yup. He says he's out for a while and we should clean
>
> Dishwasher: Okay cool. I'm going to start cleaning now

Given such a voice, these robots and software agents now have personality again, we can empathize and interact with them. We can imagine that they have inner lives. They're talking to each other, even when we're not looking. We've seen examples of this same principle applied broadly on the internet before, as memes. Doge and LOLcat are at least partly attempts to imagine, from facial expressions and posture, what sorts of questions, requests, observations, or jokes our companion species might be making, at us or at each other. There's something going on in these memes that is different from merely speaking on behalf of the animal in the photo, or using the animal in the photo the way an actor might use a mask. Science journalist and critic Annalee Newitz suggests that doge and LOLcat exist, as languages, somewhere between the subjectivity of the animal in the photograph, and the subjectivity of the viewer: "Generally, a LOLcat statement is something you're supposed to imagine the cat ... saying out loud, or it functions as a caption. Doge images feature [text] positioned around the subject of the photo. They are intended to be like thoughts, floating around in the mind of the Doge — or in the mind of the person looking at it."[12] Thinking about other subjectivities in this way might offer one means to, as philosopher of science Donna Haraway suggests, move beyond "… the culturally normal fantasy of human exceptionalism" that prevents us from understanding other forms of being in the world.[13] LOLcat and Doge both represent attempts to get closer to how nonhumans might interact without the presence or intervention of human agency at all.

To cite another example, from film studies, the Bechdel test is a workable way to articulate how movies need to represent women characters better. A film starts to do at least an okay job of that, if, as the test specifies: two named female characters, meet and have a conversation, that's not about a man.[14] Is there value in a variant on the Bechdel test for nonhuman interaction?: 'two or more nonhumans, meet and interact, in a way that has nothing to do with human agency'. This can be seen in the automated conversation of twitterbots, in the competition between high speed trading algorithms, and in the uniquely interesting interaction between animals and robots. In a 2012 video uploaded to youtube, a chicken rides a robot Roomba vacuum cleaner.[15] The chicken is sitting on the Roomba while it moves across the floor, avoiding obstacles. As it rides, it is acting as if it is walking under its own power, exhibiting the characteristic head-tracking motion common to all birds. This behavior allows chickens, when grazing, to keep track of small features and bits of food on the ground to peck at. When the chicken and the Roomba are interacting, it becomes clear that the two entities work together well because they have similar methodologies; to move across a horizontal surface in a systematic way, picking up small bits of stuff.

In speculative technology, systems like Botanicalls interpret the needs of houseplants into human readable messages,[16] while another product in development,

No More Woof, wants to interpret the gestures and sounds of dogs.[17] What if we could allow different groups of nonhuman actors to communicate with each other, and with machines, such that humans could understand and follow, without getting directly involved? And what if we could use this organizational structure to tackle a really big project, like the exploration of space and the colonization of the solar system? As a way to explore a territory and make it legible, there is potential in combining two modes: the empathy that the charismatic megafauna invokes when embedded in its environment, and the engagement that speaking subjects afford when they relate to one another. As a case study demonstration of the usefulness of networked, performative quasi-subjectivities for figuring complex territory, the following project proposes a return to nonhuman mascots for the space program, to organize and maintain interest and sympathy in culture at large for long-term space exploration and permanent colonization. As the necessary extension of the Internet of Things, this project proposes an Internet of Robots and Cute Animals in space.

THE LAZY RIVER

The designer's job, in this scenario, is to create a system that affords as many opportunities for unique and diverse interaction as possible; both within the constructed environment, and between the elements that create and sustain it. The Nonhuman Autonomous Space Agency proposes creating orbital habitats from hollow asteroids, each with a unique mashup of climate, ecosystem, species, and spatial affordances. The Lazy River is an artificial habitat with a coastal forest ecosystem, inhabited by manatees and chickens.

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In tests requiring them to learn tasks and discriminate between objects, manatees have in some cases performed as well as dolphins, if only, as biologists are usually certain to point out, a little more slowly.[18] Unique among intelligent marine mammals, their bodies are configured so that their eyes can see what their flippers are doing. There is no reason, in theory, why a manatee could not operate a touchscreen. The interaction of the manatees with each other, with the chickens, and with their software is constantly followed by ambient monitoring systems, that work to make these conversations visible to an audience of human constituents and fans who can check in anytime to watch remotely from Earth.

Figure 3: The Lazy River, Interior View

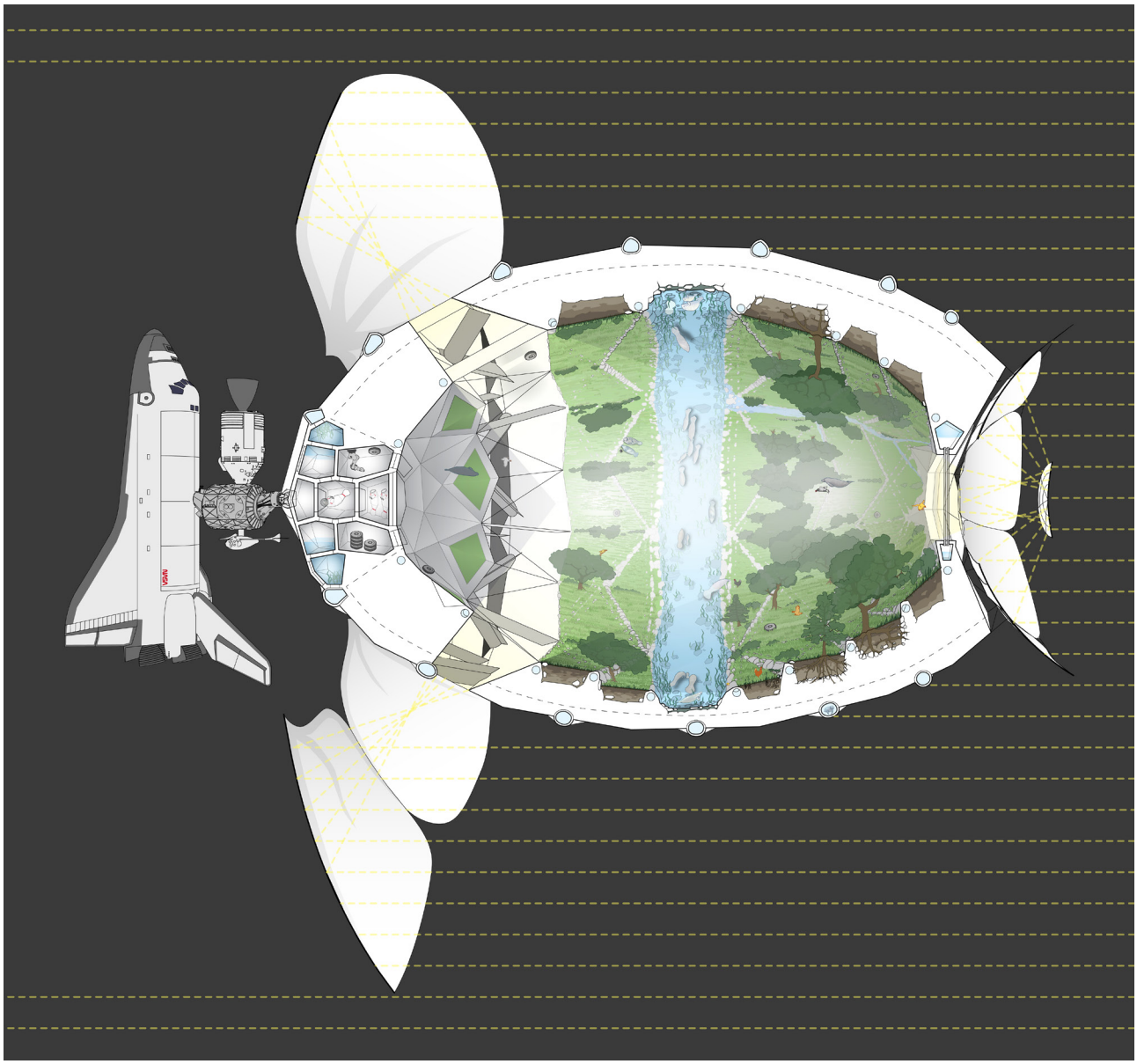

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Figure 4: The Lazy River, Section Perspective

The Lazy River is a habitat with a sevenfold symmetry, formed from the deconstruction of a source rock into its component materials, then extruded by a 3D printer and woven together, with a river around the middle, and windows fore and aft that receive reflected sunlight. The habitat is spun to simulate Martian gravity, which is about 1/3 that of Earth. This artificial gravity is light enough that the manatees can pull themselves out of the river to spend time in the meadows, and the chickens, flightless on Earth, can take off and occupy the entire airspace. A fleet of modified roombas maintains the space and interacts with the animals. There is a technical center at the hub, where the environment is regulated, the roombas are stored and repaired, and an airlock allows the manatees to even suit up and venture outside.

In 1964, Physicist Dandridge Cole proposed one method for making hollow asteroids: core out a rock and pack it with ice in the center, take a large mirror and reflect sunlight on it while it's spinning, when the rock is molten on the outside, and the heat reaches the center, the ice vaporizes and explodes, and now we have a hollow bubble of stone.[19] We can then use the mirror to reflect sunlight

inside. In the current scenario, the specifics of each habitat are tied to their methods of fabrication, their interior ecosystems, and their geometry. The image of a constellation of these habitats, in orbit around the Earth or Mars, is like cabinet of curiosities, or a collection of Fabergé Eggs, each intricate and unique. Fabergé Eggs connote a sense of infinite variety through decoration and geometry, but they also traditionally each carry a unique surprise inside, like a palace, or a ship, or even a small toy animal. The names of actual Fabergé eggs are evocative: "The Blue Serpent Clock", "The Memory of Azov", "The Diamond Trellis", "The Revolving Miniatures", "The Cloverleaf", "The Nobel Ice", "The Twelve Monograms",[20] they all suggest unique, subjective, internally consistent miniature world systems.

The fabrication machines that build the hollow asteroids in this project are attached to modified classic spaceships, like Soyuz and Apollo modules. These are independent robots that roam the system in stable transfer orbits. In the broader project, these drone robots are one of two types set loose in the solar system. The other type, solar sails like giant flowers, are much larger, and spend most their time drifting in the asteroid belt looking for rocks. When a flower finds a rock that it likes, it updates its status, and any fabrication drones nearby message it and strike up a conversation, to see if they might be compatible for a partnership in the creation of a habitat. In the scenario, their entire interaction can be followed like a story, by human fans back home.

Each robot type: drone and flower, has a portion of an ecosystem as part of their payload. One with the DNA for the flora, another with the genetics for the fauna. If they are compatible, in terms of genetics, geometry, and temperament, then they will work together to cultivate a habitat. The drone handles the manufacturing and maintenance, and the flower becomes the habitat's mirror, taking care of all of its energy and communication needs. After deciding to partner, they fall inwards from the asteroid belt to take up residence at the stable Lagrange points, or in lower orbit around Earth or Mars, and connect to the interplanetary internet, which has its major hub on the moon. The habitats with the greatest standing in the attention economy are rewarded by the moon with more material resources, which they can use to build the next generation of drones and flowers. Meanwhile, the human users can follow the daily life of the habitat's companion species. Some habitats are even synced to specific time zones, to cultivate lucrative constituencies in cities like San Francisco, Beijing, or London.

METHODOLOGIES: ON FIGURING TERRITORIES

1: Juxtapositions and Scenarios

Imagining something like a manatee in a spacesuit foregrounds and displaces some assumptions traditionally associated with the exploration of a territory like outer space. If space exploration has, in the past, been presented as a heroic prerogative of human experience, the ultimate act and even obligation of humanity, in the last and largest unknown territory, to put that responsibility literally on the back of a nonhuman is concerning. How would they feel, and what would they want to see? How would a nonhuman mammal, adapted for an aquatic environment, react to weightlessness and free-fall?

Similarly, placing the image of the friendly vegetarian manatee next to the newest generation of unpiloted military spacecraft raises questions about how and why we design our hardware in the way that we do. There is an almost unconscious tendency towards zoomorphism in the design of spacecraft, and especially

spaceplanes, with their bilateral symmetry, their directionality, their clear head and tail. This is further complicated by the new measure of independence and agency given to robotic craft with military missions like the X-37B. They already look like characters, what does it mean to give them voices and place them within stories?

2: Toys and Models

One type of tool for sketching these juxtapositions is the toy. Toy animals, toy spaceships, and toy robots, are all easy to find, easy to place next to one another in the same context, and, with simple fabrication, easy to customize and accessorize. A plastic packaging capsule, cut with a bandsaw, can become a space helmet for a toy rabbit, slicing the base of green grass from the feet of a toy chicken allows it to sit instead on top of a 3D printed roomba, downloaded from sketchup's warehouse and spraypainted in its characteristic black and white colors. There is an immediacy here in the process of representation and design. Hacking, modifying, and interacting with objects like this opens up a space between 'the toy' that is played with, and 'the model' that is used as a means to invoke a concept.

3: Offered Subjectivity

Imagining that things have voices is to invite them to interact with each other in unexpected ways. In this process it is important to remember that these voices are offered and lent from one type of agency to another, and so power differentials may come into play and obscure the interaction. How can we be sure that we are really speaking with something, and not presuming to speak for it? As writer and urbanist Adam Greenfield noted regarding the interaction of the Curiosity Rover and the rock: "Only the basalt knows what the laser feels like."[21]

5 Figure 5: The Lazy River, Section

ENDNOTES

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