Tableau machine, a creative alien presence

We present the generative subsystem of Tableau Machine, an AI-based, interactive, visual art generator. Tableau Machine is an instance of what we call an "alien presence": an ambient, non-human, embodied intelligent agent. The generator subsystem adaptively interprets sensory data (in the case of Tableau Machine, vision data from four cameras), and expresses its interpretation of the data by generating a visually interesting stream of abstract image compositions. We present a view of the design goals of our system, the design choices we took toward meeting these goals while satisfying engineering constraints and a set of lessons learned and their implications for future explorations in the space of alien presences and their creative components.

The generator's operation can be decomposed into two functions. The first function is creating a single, visually interesting image that communicates some aspects of the system's state. The second is selecting a sequence of images over time that further communicates additional information about the system's state through patterns that are only visible across multiple images in time.

Our displayed images are generated by a design grammar producing abstract constructivist styled compositions. Much previous work with design grammars has used them purely descriptively, rather than for generation. The work that uses design grammars for generation often expands the computational power of their grammars beyond context free grammars, greatly complicating them, as well as requiring additional constraint enforcing steps before a final result is produced. We use a handful of strictly context-free grammars with no parameterization to define the procedures for producing our images, providing a computationally elegant expression of the visual design spaces. Context-free grammars, however, while giving detailed expressive control over the local, structural properties in generated images, greatly lack in their ability to encode desired global, emergent properties of images. To address this, we analyze emergent properties of the images produced by our grammars using basic image processing. The context-free grammars can then generate candidate images from the design space, while the image-based perceptual feature detectors can filter generated candidates for images with desired properties. This allows us to regain expressive control over global properties of images without complicating the image generation process and allows direct mapping to image features regardless whether they are prescribed or emergent. For Tableau Machine, to ensure that images are generated in a timely manner, we pre-generate a large pool of images and run the global image feature detectors offline, indexing the images by their perceptual features.

Our alien presence can be analyzed as an embodied agent, despite its ambient nature. The installed system has visible physical manifestations but is distributed throughout a living space that is shared with observers. To meet our design goals, we crafted our agent with a static rule set deciding its actions, or deciding what kind of image to display in our case, in response to its interpretation of the input. Thus far, static rule sets have been common in the design of other alien presences such as Office Plant, a mechanical plant that reacts to email in an office setting. The static nature of the mapping is not directly visible from the outside of our system because we employ an adaptive interpretation layer that seeks to find interesting statistical distinctions in the input data, without making commitments to the semantics of the distinctions outside of its own memory. For example, our simplest mapping rule that reads "if the activity in the special zone is high, then use fast image cycling" depends on the interpretation that a certain value is classified as "high", an internal distinction that depends on the history of raw inputs the system has seen recently.

The system is fully implemented and is currently installed in several locations. The full Tableau Machine system involves several cameras installed in home, a predefined description of the connectivity of the areas visible by the cameras, and, importantly, several human beings that serve the dual purpose of observers and subjects for observation by the system. A single display is installed in a common area (such as above the fireplace), where the current image is displayed. The area of the living space near the main display holds significance for the system and serves as a starting point for exploring interaction with the system. We are currently performing a longitudinal evaluation of user response to living with Tableau Machine. For the latest installation, in the Beall Center for Art and Technology, we have augmented the system with a display that shows the recent image history so that patterns across images in a sequence are observable even by those just passing by.

The visual performance of the combined system hints strongly at creativity, both that of the system itself and the structure that alien presence affords its designers. It is not simply a visualization of input data, nor does it use its inputs as a glorified random number generator. Extensive synthesis, analysis, and brute force search enable the display of an interesting sequence of images that allow the viewer to, over time, come to understand the system's long-term interpretation of her activity, without using the simple, relatively direct, and thus, for the viewer, quickly boring mappings employed by many information visualization systems.