

Co-Creative Conceptual Art

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Abstract

This paper explores a conceptual art video presented at Works Gallery San Jose. *Arido Taurajo* is an aria in the style of Giacomo Puccini, set in World of Warcraft. The aria was co-created with Roboccini, a lyrics-to-melody system, made specifically for this artwork. We discuss the human-machine collaboration between Roboccini and the project director, and address both expert and audience reception to the work. We conclude with a discussion on conceptual art and computational creativity.

Introduction

Unlike the plastic arts¹, conceptual art is at its core atypical, de-emphasizing the object and aesthetics, and focusing instead on the meaning behind the artwork. Conceptual art frequently reflects on meaning through the process of fabrication rather than representation of the finished art object. This idea was introduced to the arts by Marcel Duchamp with the submission and subsequent rejection of Fountain to the Society of Independent Artists in 1917. Duchamp liberated art from media and demanded that it be about ideas rather than aesthetics.

Conceptual art often appears at the intersection of art & technology, like New Media, or reflects on arts inspiration, like Post Internet Art, but it always looks over its shoulder at concept or meaning of the artwork. *Arido Taurajo* combines a new approach to music creation with machinima video to tell an old and yet familiar story about life and family in a modern context.

Arido Taurajo is the first aria composed by a non-musician. This was made possible by making a co-creative system that enables human collaborators (who may not have musical expertise) to write melodies for their lyrics. To this end, we made Roboccini, which creates melodies in the style of the famous opera composer Giacomo Puccini. Roboccini takes in Italian lyrics, and responds with melodies to which the lyrics can be sung. It consists of machine-learning models trained on Puccini's music, as well as incorporating co-

*The development of Roboccini was conducted while the first author was at San Jose State University.

¹The plastic arts refers to physical media, painting, sculpture, photography, film etc. and as a description has come to refer to all visual arts.

creative functionality to give the human user greater creative control.

Arido Taurajo's director, James Morgan, collaborated with Roboccini to create the entire melody for the aria. The complete artwork relied on additional human collaborators, including a singer, producer, and machinimist, resulting in an exhibition in the 40th Anniversary show *Making it Works* at the Works Gallery, San Jose (Figure 1). Video excerpt found here https://www.youtube.com/watch?v=6G_LmxWYUOU.

In this paper, we discuss the nature of the co-creative process used to create the music for *Arido Taurajo*. In particular, we address how the director's experience co-creating with Roboccini contrasts with prior experience collaborating with human musicians. Working with Roboccini was more satisfying, and brought James deeper into the creative process. Unexpectedly, Roboccini ended up teaching through extended experience. James began to understand musical notation, and complexity of the melodies with respect to the singer's range and ability.

Arido Taurajo showcased at the 40th anniversary exhibition "Making It Works" Works Gallery and at the Paseo Prototyping Festival, San Jose, elicited the reaction of art experts. We share and discuss expert comments, as well as those of lay audiences, spanning comment on the artwork as a whole, as well as specifically addressing the reception of art co-creation by a machine.

The introduction of Computational Creativity into the process, hereafter referred to as CC, and into the conceptual art world gives rise to important questions. Conceptual art challenges typicality, and focuses instead on meaning. The current work demonstrates the participation of a machine collaborator in the role of an expert - that is, a collaborator with a well-defined expertise, who doesn't need to focus on the global objectives of the resulting artwork. We discuss how the current work, as well as art co-created by a machine in general, fit within the framework and history of Conceptual Art.

The paper begins with a discussion and technical description of Roboccini. Next, we report and discuss expert and audience reception, followed by a detailed account of the co-creative process underlying the creation of *Arido Taurajo*. We conclude with a discussion of creativity, conceptual art, and the future of large-scale productions made in collabora-



Figure 1: Installation View *Arido Taurajo, Leaving Orgrimmar*, 40th anniversary exhibition “Making It Works” Works Gallery San Jose, image: Joe Miller

tion between humans and machines.

Roboccini

Roboccini is a co-creative melody writing system which takes in lyrics in Italian and in returns melodies for these lyrics. Trained on the music of the famous Italian composer Giacomo Puccini, this system was made with the aim of giving *Arido Taurajo* Puccini’s recognizable, grand style.

This section begins with a brief discussion of related previous work, after which we present the models underlying Roboccini, and discuss its co-creative features.

Related previous work

Compared with the wealth of systems for creating lyric-free music (See, for example, an excellent overview by (Fernández and Vico 2013)), algorithmic songwriting is still in its infancy. Several songwriting systems explore the potential of autonomous algorithmic songwriting. For example, M.U. Sicus-Apparatus (Toivanen, Toivonen, and Valitutti 2013) demonstrates how the entire songwriting process can be integrated, from lyric generation to melody and accompaniment. Another interesting system, SMUG (Scirea et al. 2015), autonomously creates songs using lyrics based on academic papers. See (Ackerman and Loker 2017) for a more detailed exposition of previous work on algorithmic songwriting.

Interaction between human and machine in musical creation primary focused on music without lyrics. For instance, interactive evolutionary computation typically allows the

user to take on the role of a fitness function (Onisawa, Takizawa, and Unehara 2000), (Takagi 2001), (Johanson and Poli 1998), (Collins 2002). Another related line of work studies human-computer improvisation (Keller et al. 2006), (Kitani and Koike 2010).

A recent lyrics-to-melody writing system, ALYSIA (Ackerman and Loker 2017), was used to create English pop songs, and later applied towards the creation of art songs for Emily Dickinson’s poetry (Cassion et al. 2017). Songs created with ALYSIA can be found at <http://mayaackerman.info/alyisia.html>. ALYSIA aims to ease the songwriting process for the human user without impeding creative self-expression, in a manner useful for both professional musicians, and amateurs who may not be able to engage in this artform without the aid of a songwriting machine.

The current system, Roboccini, challenges ALYSIA’s limits by training it on songs that are different from ALYSIA’s original training data in both musical style and language. Unsurprisingly, there are stark differences in the music resulting from interaction with Roboccini versus that made with ALYSIA.

Roboccini was the first to incorporate co-creative functionality, which gives the user greater control over the melodies created by the system. For example, we’ve allowed the user to ask Roboccini to generated similar melodies to a generation that it has previously provided. Co-creative functionality was later also incorporated back into ALYSIA (Cassion et al. 2017).



Figure 2: *Arido Taurajo*, Dahlia flying over the Barrens on her way home to her family. Image James Morgan, video Chantal Harvey

Models and Features

Robocchini is based on a random forest model, trained on a corpus of Giacomo Puccini operas. The data was first gathered, pruned, then split into a training (75%) and test set (25%). For model building and evaluation, the data is split using stratified sampling along the outcome variable, which is scale degree with accent for the melody model, and note duration for the rhythm model.

The training data is built from a set of 25 MusicXML files containing complete Puccini arias. For each of the files, we identified the lead parts and extracted both lyrical and musical features. This led to about 3500 observations. Each observation consists of a combination of lyrical and musical features for the current note as well as the five previous notes. With these observations, we built two predictive models: one for pitch, and the other for rhythm/duration. Robocchini's melody model benefits from the output of the rhythm model which causes it to incorporate the latter's probability.

One of the main differences between ALYSIA and Robocchini is the language switch from English to Italian. Stress testing the structure and process of the base system using a different language and musical style proved challenging due to the required lyrics features and the increase in the complexity of song structure. Unlike English, there isn't as much support for natural language processing for the Italian language. To accurately extract the appropriate features to train the models, we had to adjust how we calculate our text-based feature metrics such as word frequency and number of syllables. We made use of a large freely available corpus of Italian works as a substitution to the Brown corpus (Baroni and Bernardini 2006).

Features extracted include:

- First Measure - A boolean variable indicating whether or

not the current note belongs to the first measure of the piece

- Key Signature - Key signature of the current note
- Time Signature - Time signature of the current note
- Offset - The number of beats since the start of the music
- Offset within Measure - The number of beats since the start of the measure
- Duration - The length of the note
- Scale Degree - The scale degree of the note (1-7)
- Accidental - The accidental of the note (flat, sharp, none)
- Offbeat - A boolean variable specifying whether or not the note is offbeat
- Syllable Type - Classifies the current syllable in one of the following four categories: Single (the word consists of a single syllable), Begin (the current syllable is the first one in its word), Middle (the current syllable occurs in the middle of its word), End (the current syllable is the last one in its word).
- Syllable Number - The syllable number within its word
- Word Frequency - The word frequency of the word which the current note/syllable is part of. This value is obtained through the dictionary frequency obtained by indexing the words of a large Italian works corpus.
- Word Rarity - A function of word frequency, as defined by (Nichols 2009). $WordRarity = 2(1 - \frac{\log_{10}(WordFrequency)}{7})$.
- Scale Degree, Accidental, and Duration of previous 5 notes

Co-Creative Functionality

As mentioned above, Roboccini was the first to incorporate co-creative features to facilitate the co-creative process.

Similarity by Distance Opera, being a sung story, can contain repeated motifs. The aim of this feature is to allow the user to repeat certain motifs in their composition. This functionality extracts note information of a user-chosen phrase and performs the cosine distance between the newly generated option and the user-chosen phrase. With this feature, the user specifies a generation and Roboccini orders newly generated melodies from closest to farthest, allowing them to discover similar melodies to those they like. This not only allows for repeated musical ideas but also helps maintain the general structure of the piece.

Connecting Phrases In order to ease the process of connecting newly generated phrases with old ones, this feature allows the user to pick any previous phrases, and create new ones that are of varying degrees of similarity. Since each of the phrases are generated independently from each other, this functionality allows the Roboccini to generate phrases that connect effortlessly. The way we achieve this is by inputting the last n notes of a sequence, $n \leq 5$, as the previous notes at the start of a new generation. This information allows the first few notes of the new melody to be based on a previous melody. One can think of the new melody as a pseudo-continuation of the former. To allow greater control over the degree of similarity, n is user-specified. This functionality has worked so well with Roboccini that we later added it to ALYSIA (Cassion et al. 2017).

Melody Creation

After the models are trained, they are used to create melodies for user-provided lyrics. Lyrics are given to the system one line at a time. Subsequently, lyric features are generated. For each line, we read the feature set from the lyrics and generate the rhythm followed by the pitches. Within each mode, *we generate one note at a time for each syllable in the lyrical phrases*. Finally, the models are used to generate the melodies, which are returned to the user, where the number of melodies is specified by the users.

In addition to the number of melodies, the user can also specify the time and key signature, as well as a special explore/exploit parameter. When predicting rhythm or scale degree (for each note), the models output a distribution over all possible outcomes. The explore/exploit parameter dictates how many samples, with replacements, we make from this distribution. The final choice is the most common draw, with ties broken by the original outcome distribution. A higher explore/exploit parameter value means we rely on the model more heavily.

Arido Taurajo

Arido Taurajo is a video comprised of an Italian aria, created in collaboration with Roboccini, and World of Warcraft machinima. “Arido Taurajo” loosely translates into “Barren Taurajo” or “Taurajo in the Barrens.” Both lyrics and visuals reflect the underlying storyline. Dahlia (our hero) is a

Tauren (half bovine minotaur-esque creature) and the region is named after her people. In this first aria, Dahlia is finishing a day of doing repetitive quests (“grinding”) at the capitol city of Orgrimmar flight point. She plans to go to her home, have dinner with her husband and tuck her child in before she joins her guild for some high level play (“raiding”). Dahlia respects the people around her, even the Non-Player Characters (NPCs) like Doras the Wind Rider Master. The aria opens with a polite verbal acknowledgement of this NPC. This is a transposition of real life into the World of Warcraft and doesn’t make much sense in the context of the game. However, it is potentially of interest to the person playing.

Connecting the world, which is often devoid of humanity, with genuine human urges, creates a beautiful contrast and allows the observer to reflect on what makes us human. Adding the subtle and casual points of contact with the people in the world along with the focus of many of our lives (family) breathes life and passion into an otherwise staid and grindy world. This humanizing factor combined with the nostalgia many players have for the world is part of the message of “*Arido Taurajo*.”

A female hero speaks to the challenges of woman gamers and the challenges that women face often being forced to choose between career and family. Our hero, Dahlia, manages to have both, and though she is just returning to the “working world” she is confident and welcomed by her guild.

The central idea behind *Arido Taurajo* is to treat the characters in the game space as though they were real people and to permit them to pursue desires that are uniquely human. The goal of this is to question both reality and the game space. Dahlia’s trip home is necessary, but having a family in World of Warcraft is neither possible nor practical (Figure 6).

This is not the final form of the work. Plans include submission to film festivals and gallery exhibitions. We intend to expand this into an operatic short, continuing to use machinima, and eventually to create a fully staged production. The slow time-line is to accommodate the creation of processes along the way and to provide time to iterate on essential features.

Machinima

Machinima, a portmanteau of machine and cinema, uses the computer screen as source material for film production, in our case we are looking at the original World of Warcraft (WoW) (Figure 2). Our reasoning for using this setting is one of practicalities, the space has an epic and nostalgic feeling for many and provides a platform for talking about the human condition. It is “large enough” to support an operatic story. Many games, like WoW, create engagement loops that require players to spend excessive amounts of time in an area doing repetitive tasks (“farming or “grinding”). This activity, while often boring, creates opportunities within the landscape for players to interact and commiserate. This is the back story of the Barrens where *Arido Taurajo* is set.

Expert and Audience Reception



Figure 3: Co-creator of Roboccini and singer, Maya Ackerman, in gallery with *Arido Taurajo*, image James Morgan

“Works is very proud to have presented the gallery premier of Arido Taurajo as a feature of our 40th anniversary exhibition ‘Making It Works.’ In this music video production, James Morgan and his collaborators brought together a surprising and inspiring mashup of opera and gaming to the intrigue of audiences from youth to seniors and in between.”

- Joe Miller, Board President Works SJ. 3

Arido Taurajo’s presence in a modern gallery setting represents a mashup of cultures. Combining gaming culture and opera in a way that appeals to a wider audience.

Several experts and audience members commented on the human-machine collaboration involved in the creative process behind *Arido Taurajo*.

“The merging of humans and technology is inevitable and in-progress. The Roboccini work is a clear and positive example of this marriage. It gives the sensation of human and artificial intelligence augmenting each other as emotion flows through the beautiful melody and voice in collaboration with the computational powers of the AI.” - Nina Colosi, Founder Streaming Museum.

Some observers quickly arrived at challenging questions that ponder what it means to collaborate with a machine when they are so profoundly different from ourselves (or are they?).

“Artists have always stretched themselves with new media, whether they worked in solitude or in collaboration. Now, the human artist has not only a new medium but a new collaborator as well. This is taking art to the next logical step in our evolution.” - Kelly Harrison, audience member.

Others expressed curiosity about human-machine co-creativity, wishing to dig deeper into the process and understand its flaws, exhibiting profound insight into the challenging nature of new forms of collaboration.

“Some of the most beautiful artworks have derived from collaboration. Often this connection can be tense, challenging but often illuminating. Most importantly collaboration embraces flaws. I wonder where and how the flaws in this AI collaboration affected the outcome of this piece.” - Danielle Siembieda-Gribben, artist & audience member.

The piece evoked feedback from musicians, who validated that the project’s succeeds in co-creating a classical

aria.

“Wow! An app did that! That’s pretty amazing. The melodic line is quite lovely and has that classic Italian aria feel to it.” -Stefanie Posner, Music and Education Director

Yet others commented on the work of art as a whole, focusing on the meaning behind the conceptual art piece, and the feelings that it evokes.

“Wow! ... Highly highly impressive! I truly enjoyed having both the visuals and the music together... The tone of the overall composition left me feeling empowered and it also gave me the feeling I get when I listen to Philip Glass’s music; where it is a silent empowerment... I also liked that it was sung by a woman (beautiful job Maya!), that again gave me a boost of that empowerment, as if to say that the ‘woman is independently traveling this world and has the ability to not only be fearless doing this, but can also control a creature who obeys her commands for travel.’ I also enjoyed that I couldn’t understand the language sung; that way it allows the viewer to ‘choose their own adventure’ and use their imagination to picture what she might be saying. Allowing the listener to feel empowered again.” - Jennifer Petush, dance/digital choreographer

Arido Taurajo was also shown at the Paseo Prototyping Festival in San Jose along with a discussion of Roboccini and has been shown at the LASER (Leonardo Art Science Evening Rendezvous) series, and in Georgia at MUME - International Workshop on Musical Meta-creation.²

In a conference setting *Arido Taurajo* is presented as a video and the audience response continues to amuse the authors. The audience is presented with a cartoony animation (from a game) that quickly changes into a musical number, in the style of Puccini. Audiences are often unsure how to respond, but the humor (Figure 5) eventually overwhelms them and they begin to laugh. The novelty then transfixed the audience for the duration of the song, which is then followed by genuine applause.

“This work renews my faith and interest in digital media art. I didn’t think there was anything this creative going on.” - comment made to board president at Works SJ exhibition.

The response has been terrific, kids love the game footage and the music; they tolerate that they do not understand Italian. Adults hear the aria and may recognize the style of Puccini, and so they are frequently able to make a connection to the game environment.

As an initial offering for a New Media Art piece, the video and aria function together and the aria can be performed separately or in conjunction with game footage (as happened at MUME 2017 in Atlanta).

Collaboration

James is a conceptual artist who works in the media of games and video (machinima). His work often considers aspects of humanity that follow the avatar into a game, and how the actions within a game environment effect the lives of actual people. James’ major works are collaborative, this is related to scale and scope of the work as much

²<http://musicalmetacreation.org/workshops/mume-2017/call-for-participation/>

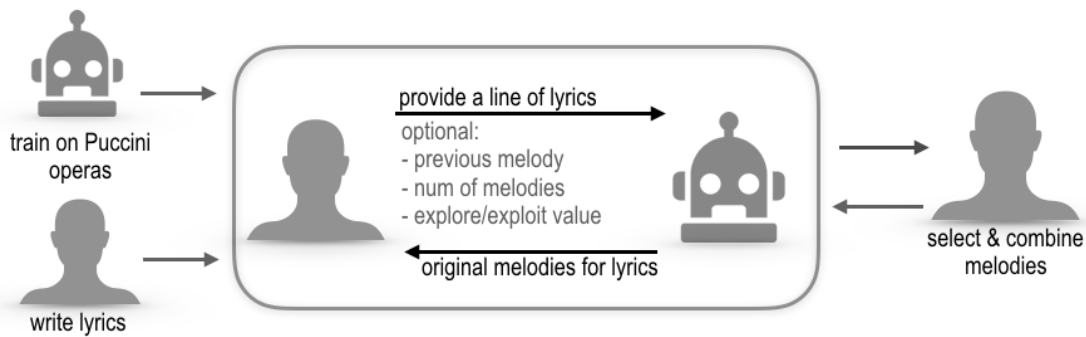


Figure 4: An illustration of the human-computer collaboration in the creation of Arido Taurajo. After training Roboccini on the music of Giacomo Puccini, James repeatedly called Roboccini to generate melodies for one line of lyrics at a time. James then selected amongst Roboccini’s suggestions to create the aria.

as his desire to interact with people in the process of creation. Larger works requiring broader expertise demand either greater time or expert collaborators.

As a person with no musical skills, the contrast between collaboration with Roboccini and human musicians is stark. James’ earlier work “Einstein’s Special Theory of Relativity: The Musical”³ was written with human collaborators. Human musicians perform like a black box, taking input and creating based on it, the process relies on the aesthetic, passion and commitment of the musicians. Roboccini on the other hand demands that the artist select, arrange and tune. Roboccini opens the process to deep and meaningful collaboration on a granular level. Furthermore, working with Roboccini created learning opportunities. This again becomes part of the collaborative experience. The artist inadvertently started to learn the basics of reading music, and began to understand its basic structure.

Roboccini is the expert and the musician. James had worked with musicians before, but not quite as closely as he had worked with Roboccini. The artist had to feed Roboccini lyrics and sift through its suggestions (see Figure 4 for an illustration of the co-creative process). In the past, working with human collaborators he would present the lyrics, wait a few weeks and have a “finished” work. As an artist, and a director, this is efficient but not terribly satisfying.

In the production of this aria, Roboccini fulfilled the role of an expert collaborator. Roboccini’s expertise was baked into every interaction, and never wavered. Initially there were challenges with communication and patterns of production but experience dictates one always adapts to one’s collaborators. In this case there was a play between use of the tools and the process for creating the melody for the aria. James had to figure out how to collaborate and frequently asked for revisions, Roboccini always responded. This let him have more of a hands-on approach in a field in which he has no expertise. As director, James had to accommodate the singer, her range and the complexity of the melody.

³James Morgan, 2005. Einstein’s Special Theory of Relativity: The Musical. IMDB: <http://www.imdb.com/title/tt1557564/>

Roboccini could create a ridiculous amount of melodies and as a collaborator James’ task turned to working to refine and simplify these.



Figure 5: *Arido Taurajo* Dahlia sings about a familiar character in Barrens chat, image James Morgan, video Chantal Harvey

Dealing with Roboccini’s quirks (only understands 19th century Italian) became a constraint that challenged James’ artistic practice. Roboccini understands Italian and James does not, so English lyrics needed to be translated into contemporary spoken Italian before the software was able to generate melodies. Similarly, as is often the case with NLP dictionaries, Roboccini’s Italian dictionary was incomplete. This makes it difficult to create meter and rhyme schemes for words outside of Roboccini’s scope. Thankfully Roboccini accommodates revisions, and in the end the language difference provides a layer of mystery and style. Viewers recognize Italian, and make a connection with classical opera which gives the work a sense of high culture.

Roboccini also demanded that James give it lyrics one line at a time, but he found that he could cheat by queuing up the lines that he was interested in and having melodies generated for a large volume of content at one time. Using a command line interface made it simple to generate a wide variety of

input. This actually became a problem as creating melodies was far too easy.

Roboccini fed his desire to make music and provided some structural constraints, but no constraints on how far he could take it. Roboccini let James retain all of its work and peek behind the creative curtains to see all of its variations, he held onto these during the process of writing and found that it not only gave him readily available alternatives but an almost infinite variety of combinations. This also became useful as he had to accommodate the vocal range of the singer.

Roboccini was limited in one crucial aspect upon which we built an aria and a video. Roboccini understands melodies and Puccini's style, but understands less about the greater meaning of the work. Working with experts demands the ability to look at the project holistically. This responsibility falls on one individual, the director, while Roboccini plays its part as a composer.

Alternating and task-divided human-computer co-creativity is handled organically, with each party taking on functions within its expertise. In this case, the human "director" is responsible for being aware of all the requirements of the collaboration. For example, the range of the singer, the length of the piece, and the "landscape" of the melody. In that way, certain portions of the song can be emphasized and coordinated with the video.

The director relies heavily on the musical expertise of the computer collaborator that is refreshingly eager to redo, replace and re-create various aspects of the melody. Roboccini, in this case is exclusively responsible for certain aspects and is effectively coached into an effective integration of its work.

Discussion: Creativity & Conceptual Art

Arido Taurajo is a work of conceptual art that is by necessity collaborative. It benefits from collaboration because of the number of moving parts and essentially requires expertise in the following areas: environment/game knowledge, libretto, contemporary Italian, melody creation, singing, musical accompaniment and production, puppeteering (machinima), video editing. The director's job is to hold all of this within a single vision and marshall the co-creative process through-out.

How is this a work of conceptual art? Conceptual art breaks from the foundations of art in 1917 with Duchamp's *Fountain*. A urinal placed into an unjuried exhibition (and rejected). This act of artistic creation is acknowledged later by Kosuth as one of the first examples of conceptual work.

Conceptual art is about the idea or meaning behind the art rather than the aesthetics or what it looks like. Kosuth says, "All art (after Duchamp) is conceptual (in nature) because art only exists conceptually." (Smith 2011) For artists, this is liberation from any requirement of form, function, aesthetic or interpretation. Fundamentally due to the movement of conceptual art in the 1960's and 1970's there is no limitation to media or representation, this also frees the "artist" to be non-human.

The tradition of "found art" exemplifies this, "found art" is not art that is created, but art that is recognized by the artist

and later described as and "made" into art through context. The context may be a museum or gallery or simply writing or discussing the piece as a work of art.

The current work explores a machine collaborator in the role of an expert, focused on a specific, well-defined task, which the human director utilizes to create the grand vision. The next step may involve machine collaboration on the meaning and global direction in the creation of a piece of Conceptual Art. What would it be like for a conceptual artist to collaborate with a machine that is able to infer and assign meaning, or have creative disagreements with the artist? Works towards creative internationality in CC system applied to the visual arts is an ongoing area of research ((Norton, Heath, and Ventura 2013), (Colton et al. 2015)). Conceptual art, even more so than other art forms, emphasizes meaning and intentionality. Applying machine internationality to collaborative conceptual art may lead both artists and CC researchers to exciting new terrains.



Figure 6: *Arido Taurajo* Dahlia arrives home and is greeted by her husband Diesel and child Calvin, image James Morgan, video Chantal Harvey

Musicals and Operas: The Next Step

Perhaps the most culturally significant large-scale human-machine collaboration was a musical put on at London's West End for a two week run at the end of 2016. "Beyond the Fence" explored the potential of computational creativity systems to assist with the making of full-scale stage productions (Jordanous 2016). This massive undertaking, which involved both a production and documentary of the creative process behind it (Productions 2016), successfully raised the profile of computational creativity research in the public eye (Jordanous 2016).

Members of the human creative team demonstrated commitment to relying on the output of CC systems, even when it proved challenging, saying "we have to honour what we've signed up for." One of the biggest challenges turned out to be the juxtaposition of text with melody, which stands at the heart of songwriting (Productions 2016). Expert humans were left struggling to create coherent songs that would incorporate parts of music and lyrics created by computer systems.

Naturally, and without downplaying the incredible accomplishment that is “Beyond the Fence,” it is safe to say that we would like CC systems to enrich and simply the creative process, rather than pose a challenge.⁴ Furthermore, machine collaborators should increase access to creative tasks, enabling the creation of musical, or opera (etc), by humans who may not have been able to participate in this artform without the machine collaborators.

Roboccini, and its sister system, ALYSIA, make a specific creative task, songwriting, both easier and more accessible. Notably, Roboccini solves precisely one of the issues found to be most challenging during the creation of the musical, the juxtaposition between lyrics and melodies.

Roboccini was essential to the creation of *Arido Taurajo*. The director using Roboccini, a non-musician, could not have made the aria without collaborating with Roboccini. Perhaps if another (co-)machine-made musical were to be made today, Roboccini or ALYSIA could make it easier.

What does the future of culture and CC hold? Can we imagine the creation of a musical, or opera, with an effective team comprised of both humans and machines? Rather than struggle to incorporate a machine’s suggestions, human artists of the future may be eager to work with machine collaborators that simplify the creative process and fill in skill sets that the humans lack. Machines might empower the human artist, inviting them into the creative process, making the process more transparent than a typically human-to-human collaboration, as Roboccini did for the director of *Arido Taurajo*.

New Media artists hunger for collaborators and new forms of production to play with. The computational creativity community could benefit from early partnerships with artists collaborating with their AI’s to co-create new work. Earlier communication in the process of creating and working with AI’s will serve to create deeper collaborative connections. Artists, AI’s, and CC researchers iterating to better understand each other’s requirements may lead to richer and more satisfying collaborations, to the extent that human-machine collaborations in the art world may become commonplace.

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⁴It is worth noting that not all of the CC systems used in the making of “Beyond the Fence” posed challenges. It is further unsurprising that the very first attempt of a machine-human collaboration of this magnitude would uncover opportunities for improvement.