Teaching Computational Regionalism

> If modernity is essentially characterized by the correlated notions of progress and overcoming, then the idea of simply rejecting modernity – rejecting it, say, for some new stage of history – leads to a double bind: for to reject modernity is also to reject the possibility of overcoming modernity.[1]
>
> — K. Michael Hays

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INTRODUCTION

In his seminal text, *The Logic of Architecture: Design, Computation and Cognition*, digital design pioneer William J. Mitchell states that "architecture is an art of distinctions within the continuum of space" (Mitchell, 1990). Mitchell describes how the perception of difference through distinctions in quality, intensity, extension and duration continues to be the driver of all visual and spatial endeavours. Today, two decades after the publication of Mitchell's book, cultural distinctions are fast becoming blurred in favor homogeneity driven by globalization. This emerging cultural homogeneity has inescapably trickled down into the production of architecture. While the universal pervasiveness and democratization of computational design methodologies in architecture and allied fields continues to radically transform the ways in which we generate innovative ideas and communicate them, one cannot ignore that an alarming air of sameness and homogeneity continues to mark architectural endeavours globally.

This emerging homogeneity in material culture has made its way violently into the Middle-East, an area historically known for its very particular and innovative attitudes towards material culture. Here, architectural practices and academic institutions continue to suffer from two Neo-Orientalist attitudes that are both amplified by the pervasiveness and democratization of computational design methodologies. The first attitude is the indiscriminate importation of western models of living and production in the search for an ever-elusive edge over competition. The second attitude is the regression into the proliferation of pattern as surface ornamentation in the search for an ever-elusive sense of tradition. This second mode of production has been amplified by the ease of which parametric design tools deploy pattern-driven techniques. Both these attitudes continue to turn a blind eye towards social, cultural, political and ecological specificities that exist within the contemporary Middle-East that clearly indicate that neither Western nor historical models can thrive. Educational institutions are not free of blame either, as the Middle-East's educational programmes continue to operate in one of two failing models; the first operates in defiance of global models, preferring age-old archaic strategies, and the second imports non-adaptive western educational models. Both these attitudes are a result of a new kind of Orientalism emerging from the pervasiveness of information and technology, defined here as *Computational Orientalism*.

This paper describes a teaching pedagogy that is being developed in at the Department of Architecture, which is situated within the College of Architecture, Art and Design at the American University of Sharjah, U.A.E. The foundation of this developing teaching pedagogy is developed through the belief that battling the emerging homogeneity in Middle-Eastern material culture can be achieved by critically viewing computational design methodologies through a historico-cultural lens to generate a design methodology that are historically relevant and in communication with the age of computation.

The paper is structured in three parts. First, it will outline a theoretical framework and research methodology as vehicles for the development of teaching and research pedagogies. Second, it will describe the early endeavours through student work developed under this pedagogy. Finally, the paper will attempt to draw future trajectories based on the knowledge gained from the work that has recently been produced.

ORIENTALISM REBRANDED: COMPUTATIONAL ORIENTALISM

Orientalism, a term coined by the Arab scholar Edward Said in 1978, refers to a historical and arguably ongoing Western-centred attitude towards geographies and cultures that lie to the east of Europe. In the opening of his pioneering and controversial book, *Orientalism*, Said writes that "the Orient was almost a European invention, and had been since antiquity a place of romance, exotic beings, haunting memories and landscapes, remarkable experiences" (Said, 1978). Sibel Bozdogan, a leading architectural historian that continues to work on the development of Orientalism as it relates to architecture, explains that the implications of Orientalism to material culture in general, and architecture in general lie in that it directs "how a culture is perceived, described and ultimately reconstructed by another, often gravely reducing, schematizing and distorting the image according to the predilections of the beholder" (Bozdogan, 1986).

Technology has always been a tool in the deployment of Orientalist attitudes, and current advancements have not shied away from this tradition. *Computational Orientalism*, within the context of this pedagogy, refers to the ongoing practice of legitimizing the superficial deployment of historical patterns in various scales, ranging from aperture screens, landscapes, and masterplans. This neo-orientalist and naïve practice, results in a violently imposed homogeneity in contemporary architectural practices in throughout the Middle-East. This is directly driven by how computational design methodologies have revived architects' interest in pattern-based and geometry-driven practices. While this has created an unprecedented productive explosion within the design research community on multiple fronts, it seems to have only legitimized the superficial use of historical patterns in Middle-Eastern design practices; hexagons reign supreme, and because they are generated by the newest computational tools, they are deemed good and beyond reproach.

While many designers are using computational design tools to radically question issues of space conception, building performance, construction methods and material sciences, the common practice in the Middle-East is to continue to present skyscrapers spatially conceived as a typical North American tower dressed in historical geometric patterns.

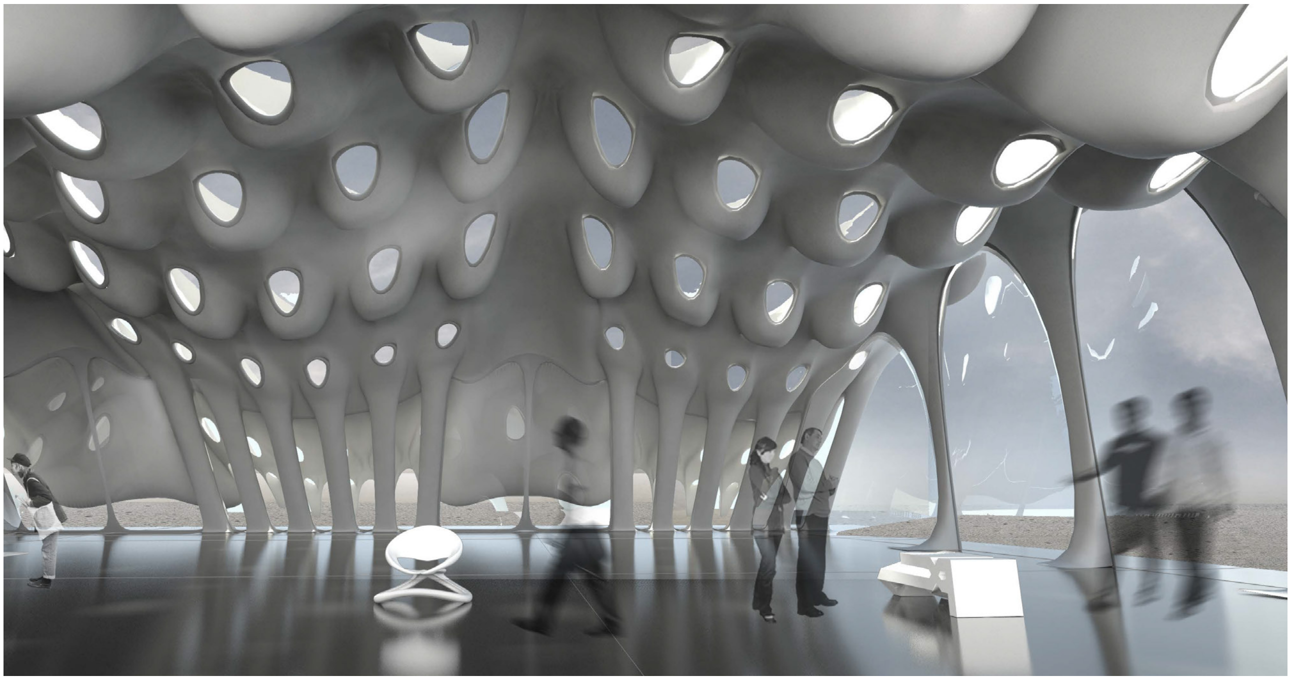
METHODOLOGY

This body of work breaks away from the mainstream practice of referring to the historical work in question as Islamic. While it is undeniable that the emergence of Islam in the 7th century and its rapid expansion throughout the Arabian Peninsula and beyond radically affected the development of the region's art and material culture through its shift from iconographic practices towards geometric ones, the paper shies away from the term Islamic because it has the potential to be understood as reductive of the complex demographic, cultural and religious condition that existed and continue to exist within the region. In a book titled *Islamic Architecture: Form, Function and Meaning,* Robert Hillenbrand cautions those interested in understanding Islamic Architecture by pointing to the diversity of Islam in terms of geography and time periods. Lucidly, Hillenbrand gives the clear example that "8th century Syria and 15th century Spain are worlds apart" (Hillenbrand, 1994). It is in this vein that this body of work adopts the term Middle-Eastern material cultures. Specifically, realizing that concept of the Middle-East is in itself controversial and at times vague, the research views the Middle-East through an all-encompassing lens spanning the Arabic speaking world from the edge of the Atlantic in the west to Yemen in the east including modern day Iran and Afghanistan.

Studies in the history and taxonomies of Middle-Eastern architecture have largely been based on programmatic typologies such as mosques, mausoleums, palaces, bazaars, of which Robert Hillenbrand's *Islamic Architecture: Form, Function and Meaning* is a seminal example, or typologies of architectural elements such as gates, screens, muqarnas, and the all too iconic minaret. Hillenbrand's methodology of typological categorizations allows for a formal analysis to bear fruit through the consolidation of focus, however, this body of work deviates this form of programmatic or elementary categorizations in favour using geometric typologies (lines, surfaces and volumes) as a springboard for the research. While it is important to understand the historical and social context in which programmatic and architectural typologies emerged, the goal of this body of work is to develop a contemporary material culture for a contemporary lifestyle. Hence, the study proposes to take as a starting point in its exploration the deployment of geometric typologies (lines, surfaces and volumes) in historical contexts, irrespective of its context such as programme, architectural use and scale. More specifically, the work described below builds heavily on the historical strategies of deploying line geometries across a multitude of scales.

EARLY TYPOLOGICAL REINTERPRETATIONS

The shift from exploring building typologies as generative starting points towards exploring geometric typologies and their uses in historical contexts was as a response to some early studies that explored building typologies. Early in the development of the pedagogy students were asked look at a building component/typology and rethink ways in which computational design methodologies can generate novel interpretations that share certain performative and visual aspects with the historical typology.



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A project that exemplifies this early strategy is one that looks at domes typically used at Aleppine public baths. These domes are characterized by visual porosity that is a result of patterned circular openings where glass spheres were inserted to maximize daylight. This kind of porous structure offered ample ground for reinterpretation through computational design methodologies because it allowed for porosity to be generated through an interplay of pattern deployment and repetitive topological operations as shown in Figure 1.

Another example that follows this strategy was the reinterpretation of a muqarnas dome, seen in Figure 2. such as the historical Sit Zubaida Khatoon Mausoleum in Iraq, built at the beginning of 1200s AD. A muqarnas is corbelling strategy utilized in Islamic Architecture characterized by the use of self-similar geometries at differentiated scales.

While this typological strategy produced some novel architectural conditions and highly utilized computational design methodologies, they were unable to truly move away from a very linear interpretation of historical architectural conditions. This was a strong factor that influenced a shift towards the deployment of line geometries as vehicle for defining a singular unifying element within the diverse history of Middle-Eastern material culture can be understood through the following short introduction to the way history is viewed within this pedagogy.

A COMPUTATIONAL MATERIAL CULTURE

Islam's shunning of iconography, the modus-operandi in neighboring practices such as in Byzantium and Persia during its emergence, led to a shift away from the representational and iconographic towards the geometric and constructed.

Three computational practices emerged during this aesthetic and material shift. These practices can be described as (a)*calligraphy*, the art writing, (b)*geometric patterning*, the generative practice of symmetrical subdivisions to create high resolution geometric patterns, and (c)*Arabesques*, which are foliage-like spline geometries (Sutton 2007). Visually, these practices share all exhibit an

Figure 1: Student work (Narges Rowshanzamir). Reinterpretation of domes used in Aleppine public bath, *Porous Shell.*

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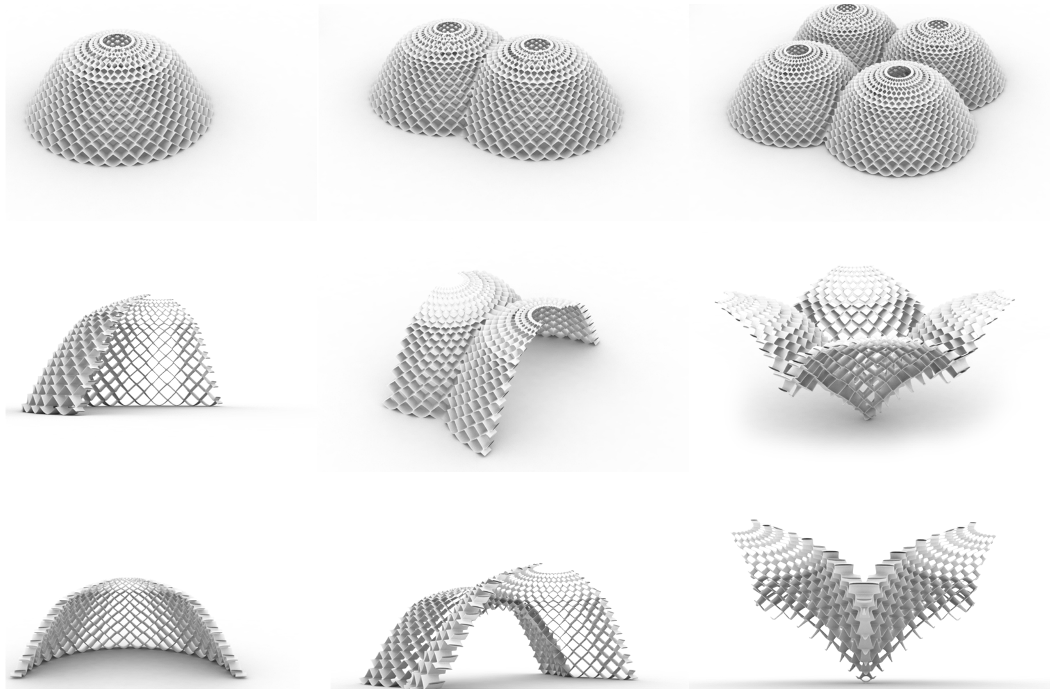


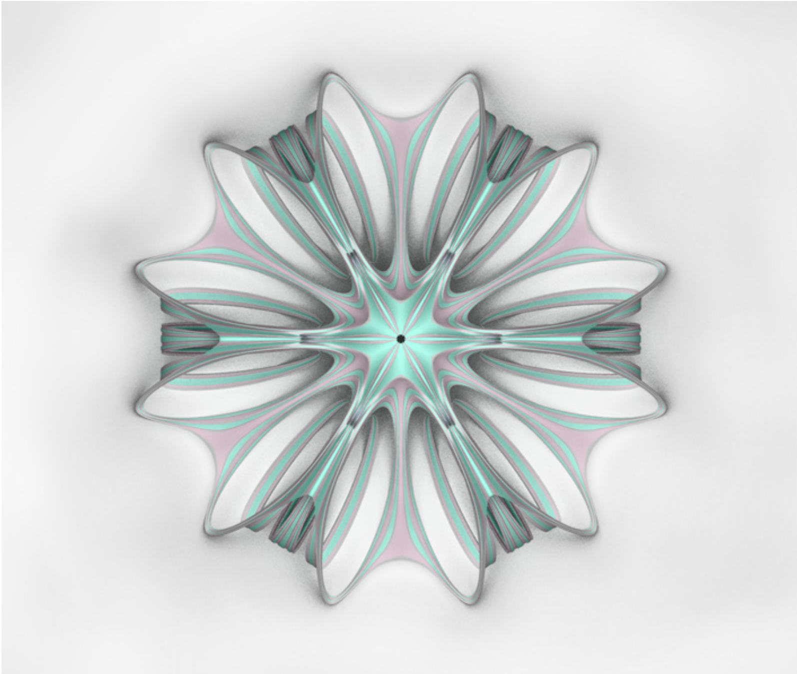
overarching use of systemically organized line geometries to generate adaptive multi-scalar patterns. On a foundational level, these material practices and contemporary computational models have three shared values in common. They are both (1)generative, (2)systemic, and (3)adaptive.

Within the teaching and research environment, generative design is understood as a design strategy that employs an algorithmic strategy to develop output. Students are asked to consider the following three questions through a feedback loop model that deviates from linear design attitudes when operating generatively: (1) What are you trying to achieve? (2)What is the algorithm (or logic) you are employing? and finally, (3)How do you evaluate your work? Through generative design methodologies, students are given the opportunity to quickly develop variations on a singular theme, necessitating the ongoing refinement of evaluation criteria, as is reflected in the third question above. This ability to create near-infinite variations on a singular theme is a defining characteristic of all three material practices introduced above. For example, geometric patterning techniques have historically relied on the deliberate organization of circles to create intricate near infinite Cartesian patterns where the geometry of a line operates on multiple levels of hierarchy.

Designing systemically through a computational methodology implies building complex part-to-whole relationships. In the three material practices mentioned above, line geometries of various degrees of curvature form the simple parts that aggregate generatively to create complex fields, akin to big-data structures. This is practiced in this teaching and research pedagogy through both, the development of emergent systemic interactions in the form of procedural computational logic and through resultant architectural expressions.

Finally, both Middle-Eastern material culture and computational design methodologies are conceived as adaptive systems in that they can be appropriated in various scenarios. The three Middle-Eastern practices mentioned above were adaptive in that they were appropriated for calligraphy, textile design, jewelry,

Figure 2: Student work (Eithar Algebail). Reinterpretation of the muqarnas dome, *Porous Muqarnas.*



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pottery, armor design, architecture and other material practices. Computational design methodologies are adaptive in that they allow for radical differentiation through minimal changes in the code structure.

Operating generatively, systemically, and adaptively echo a 2014 seminal article published in *Artforum* by digital theorist Mario Carpo titled “Breaking the Curve: Big Data and Design.” Carpo calls for the obsolescence of spline based geometries that were heavily used in the early digital revolution and describes what he sees as a shift towards big data structures. Of big data, Carpo write that it is “a disorderly offspring of post-modern digitality, is a tool for coping with, managing, and some would even say extolling complexity” (Carpo, 2014). The problematic created in echoing Carpo’s work is that Middle-Eastern material culture is both, relevant to big data in that its digitality, to use Carpo’s term, produces high resolution field conditions whose underlying structures that cannot be immediately discernible by the naked eye, but heavily reliant on spline curves. This has occurred because in an attempt not to fall into the same Computational Orientalism that the pedagogy is trying to resist, an active rejection of Cartesian geometric patterns in favor of computational and interpolative spline geometries that are the basis of Arabesques, a practice that has not yet been exploited from a Computationally Orientalist point of view.

STUDENT WORK

The development of the teaching pedagogy began in Fall of 2011 through practice/research and teaching design studios and advanced computational design seminars at the undergraduate level at the College of Architecture, Art and Design (CAAD) at the American University of Sharjah (AUS) in the United Arab Emirates (U.A.E), a city twenty minutes drive north of Dubai. Due to the institution’s location, CAAD and AUS house a diverse cultural mix amongst faculty members and students. Understanding the particularities of the institution in which this pedagogy is currently developing highlights how the process can be adaptively deployed within other teaching contexts that are struggling with similar issues in the Middle-East or beyond.

Figure 3: Student Work (Aya Shaker). Explorations in procedural systems based on Geometric Patterning techniques, *Symmetries*.

Understanding this specificity allows for teaching opportunities that might not be available when teaching computation design methodologies elsewhere. While teaching the tools at introductory levels reflects similar modes of teaching globally, students at the higher levels explicitly understand the goals of this teaching pedagogy. After a quick excursion with developing strategies of deploying historical patterns through computationally topological means was abandoned (Figure 1), the last two years have focused on two teaching and research trajectories: (a) Spline Assemblies and (b)Spline Formations. Most recently, the body of work has weighed heavily towards the further developments of Spline Formations for reasons to be discussed below.

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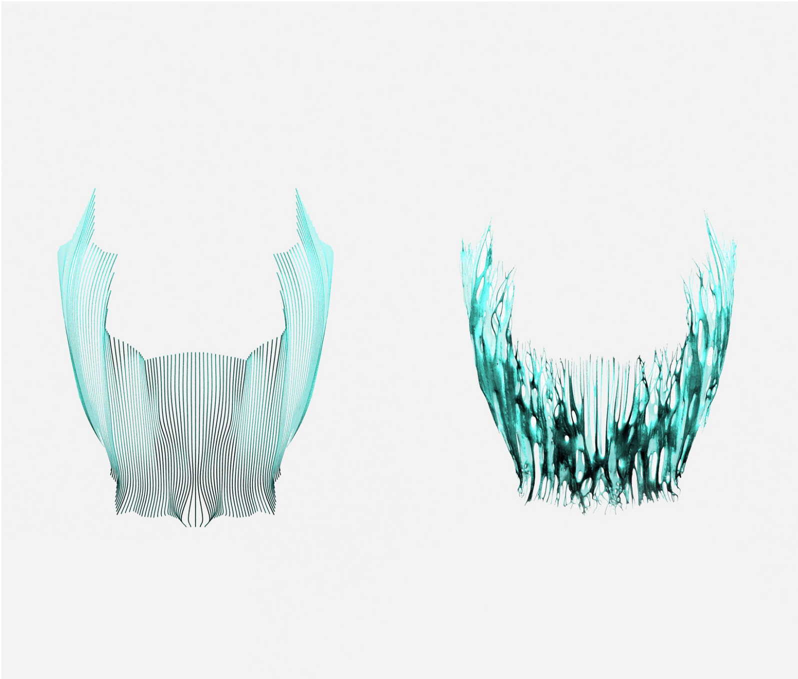
SPLINE ASSEMBLIES

Projects under the Spline Assemblies umbrella have explored the systemic and performative aggregations of structural tubular members to create highly differentiated inhabitable field conditions. These are computationally conceived through parametric models where splines respond to both, neighboring conditions but are also optimized for structural performance. Moreover, these exercises are coupled with analogue form finding methodologies where steel or copper rods are manipulated to create an understanding of what is possible to create within such a system.

The relationship between these Spline assemblies and Middle-Eastern material culture is that Arabesques employ spline interpolations. Arabesques are radically different from Geometric Patterns in that they cannot be described purely in Cartesian space. While initial set outs responds to Cartesian space through the use of circles, the move away from fixed radii circles that are the basis for Geometric Patterns allows for a subsequent shift from Cartesian lines towards splines. In essence, splines are an approximation, and more precisely, an interpolation method that results in a smooth curve.

Figure 4: Student Work (Hafez Koohestani). Spline Assemblies create highly textur z zv spatial conditions, *Vectorial Tectonics*.



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The resultant visual quality of these tectonic assemblies resembles much of the iron work that was produced in the Middle-East; Non-linear field conditions that exhibit extreme flow and moments of local asymmetry.

SPLINE FORMATIONS

Student projects that investigate the Spline Formations do not conceive of their material condition as that of a tectonic assembly of multiple objects. Here, material conditions move away from the conception of form as discrete and definable conditions towards understanding form as a process in continuous formation and flux in the search for optimum defined criteria such as enclosure and structure.

Spline Formations have been explored in two computational spaces: (a)physics-based software that allows for control and customization through high-level programming language and (b)Object-Oriented Programing (OOP). In both models, points are distributed in space in accordance with a rule-based logic, after which splines are deployed to interpolate between said points to create an armature on which computational material, i.e. a computational particle system can be deployed. Coined in 1982, “a particle system is a collection of many many minute particles that together represent a fuzzy object. Over a period of time, particles are generated in-to a system, move and change from within the system, and die from the sys-tem” (Reeves, 1983).

In much of the same way that the preceding description on Spline Assemblies notes that resultant assemblies exhibit highly textured and non-linear field conditions that exhibit extreme flow and moments of local asymmetry, these formations result in similar conditions except that here, tectonic part-to-whole relationships are displaced for a more singular material system, akin to bas-reliefs and carvings found in Middle-Eastern material culture.

FUTURE TRAJECTORIES

There are two trajectories that this body of work can be simultaneously driven towards. First, the body of work must further focus its target towards a singular

Figure 5: Student Work (Hala Al Juboori). Explorations in physics-based spline modeling, Local As*ymmetries*.

direction, fusing Spline Assembly logics with Spline Formation expressions. This has recently begun through further contextualization in the form of the deployment of the pedagogical attitude specifically on regional space-types such as central dome spaces or column-grids. A much more robust taxonomical exercise must take place in order to make significant strides forward. A series of proto-architectural conditions have been explored that shares the same goals with the preceding teaching endeavours.

The relationship of this branch of the research to the larger umbrella of is Computational Regionalism is that it adopts two distinctively Middle-Eastern spatial typologies in an attempt at hybridizing them into a contemporary spatial condition. The first typology is the all too familiar dome, historically conceived as surface-field condition, where surface represents enclosure and fields is the domain of ornamentation. The second typology is the column grid, historically conceived as a strongly integrated line-field (or field of lines) condition. This starts by developing a computational code that can be deployed to create either structures that exhibit domeness, or those that exhibit columness. Afterwards, students are allowed to explore the potentials of such a code-based logic through alteration and amalgamation.

The second trajectory stems from the view that the attitude describe above is an adaptive pedagogical prototype that can be deployed in regions where a globalized homogeneous material culture threatens to eradicate cultural forms of production. This is driven by the belief that contextualizing computational design through a historico-cultural lens will invariably elevate the design discourse wherever it may be, in turn elevating the role in which design can play in building contemporary post-post-colonial societies.

ACKNOWLEDGEMENTS

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ENDNOTES

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