Designed for the context of the Al Fahidi cultural district, Dubai’s oldest settlement, Resonant Surface 01 combines acoustic performance and contextual aesthetics through a study of musical instruments and Islamic geometry. Inspired by the loudspeakers on top of Minarets and the huge banks of speakers at rock concerts, the piece lends spatial and aesthetic character to devices that are typically seen as undesirable but necessary hardware. Parametric and digital fabrication tools allow the form to be acoustically responsive, while mediating the scale of the human body and that of the architectural surface.
Referencing both the complex tiling and vegetal arabesques of Islamic architecture, the piece combines planar mesh tiling with spiralling, interlaced curves. Convoluted to fit into a 1.5m x 1.5m x 1.7m volume, seven three-meter-long horns mediate the space between the exterior of the volume and its center where they coalesce at a mouthpiece. Designed to resonate in response to the human voice, the horns accommodate the length of sound waves ranging from a bass tone with length of 3m to soprano or even higher tones less than 1 inch in length.

Along their length, the horns evolve from mouthpiece to tube to cone and finally flare section. Each section of the horn affects the sound waves it contains, initially compressing then expanding and directing the sound. Curvature like that in musical instruments allows the sound to travel smoothly through this transition. In contrast to the smooth length of the horns, the cross section is faceted to rationalize the geometry into ruled surfaces. This formal typology allows the horns to mediate between the crystalline geometry of the exterior frame and the curvilinear geometry needed for acoustic performance.

Derived from a composition of seven octagonal tiles wrapped around a cylinder, the exterior frame is distorted to respond to the ground and sky. Inscribed within each tile, the frame is filleted to soften the mesh geometry by creating a secondary porosity. The outer layer of the 4mm thick, 25mm wide aluminium frame is cold folded between tiles using a custom undulating toolpath. Velcro connections between the frame and outer edges of the horns prevent acoustic dampening, allowing the resonant surfaces to vibrate independently.
3 Detail of aluminum frame to wood veneer surface connection (Yogiaman, 2014)

4 Resonant Surface 01 back elevation. SIKKA 2014 Exhibition, Al Fahidi in Bur Dubai (Roldan, 2014)

5 Resonant Surface 01 interior mouthpiece. SIKKA 2014 Exhibition, Al Fahidi in Bur Dubai
Laser cut strips of thin veneer plywood comprise each of the horns, which expand from four strips to eight. Bespoke tabs were designed to allow for tight, toolless assembly of the wood strips. Unlikely patterns emerge from the unrolled strips, which are designed parametrically using a centreline and profile curves. Rationalized using the Grasshopper plugin for Rhino, the convolutions, surface patterns and connections can be modified in a single script, allowing the complex assembly to be iteratively modified to accommodate performance and fabrication criteria.

This project shows how even a quick experiment using rigorous geometry and digital tools can start to redefine traditional formal tropes while responding to context, performance and identity.

CHRISTINE YOGIAMAN is an Assistant Professor at American University of Sharjah, where she teaches architectural design. Focused on digital technologies in early architecture design education, Christine has coordinated the Graduate Core studio sequence in conjunction with her development of a digital curriculum at Washington University in St. Louis. Christine directs Yogiaman Tracy Design, currently designing projects in Indonesia that focus the utilization of digital technologies techniques along with contextual influences to create culturally embedded, affective work. She has received third place for 2012 Steedman Fellowship international design competition, and has won the 2012 TEX-FAB APPLIED: Research through Fabrication competition.

KENNETH TRACY teaches architectural design at the American University of Sharjah where he is an Assistant Professor of Architecture. Tracy has taught at the Pratt Institute, Columbia University, the New Jersey Institute of Technology, as well as Washington University where in 2009 he established the Digital Initiative CNC Research Lab. Tracy holds a Master of Architecture Degree from Columbia University and Bachelor of Design Degree from the University of Florida. In 2005 Kenneth co-founded Associated Fabrication, a digital fabrication shop in Brooklyn, New York. Currently Tracy co-directs Yogiaman Tracy Design whose research includes designs, lectures and writing related to digital techniques and culturally resonant craft practices.

IMAGE CREDITS
Figures 1, 4: Juan Roldan
Figures 2, 3, 5, 6: Christine Yogiaman