McGill AMMAR Assembly Instructions

Introduction

Location

AMMAR is designed to be used in a large, semi-anechoic environment. The apparatus requires a flat surface of 2.5 meters (8') by 1.2 meters (4') and height clearance of 3 meters (10'). The weight is well distributed to be used on an acoustically-absorbing carpet matting. The host control digital audio workstation can be remotely located as much as 100 meters (330') away. The digital audio processing unit (DAPU) of the workstation is specially designed to be ultra-low noise. There are advantages to locating the workstation in proximity to the apparatus, if the noise is tolerable.

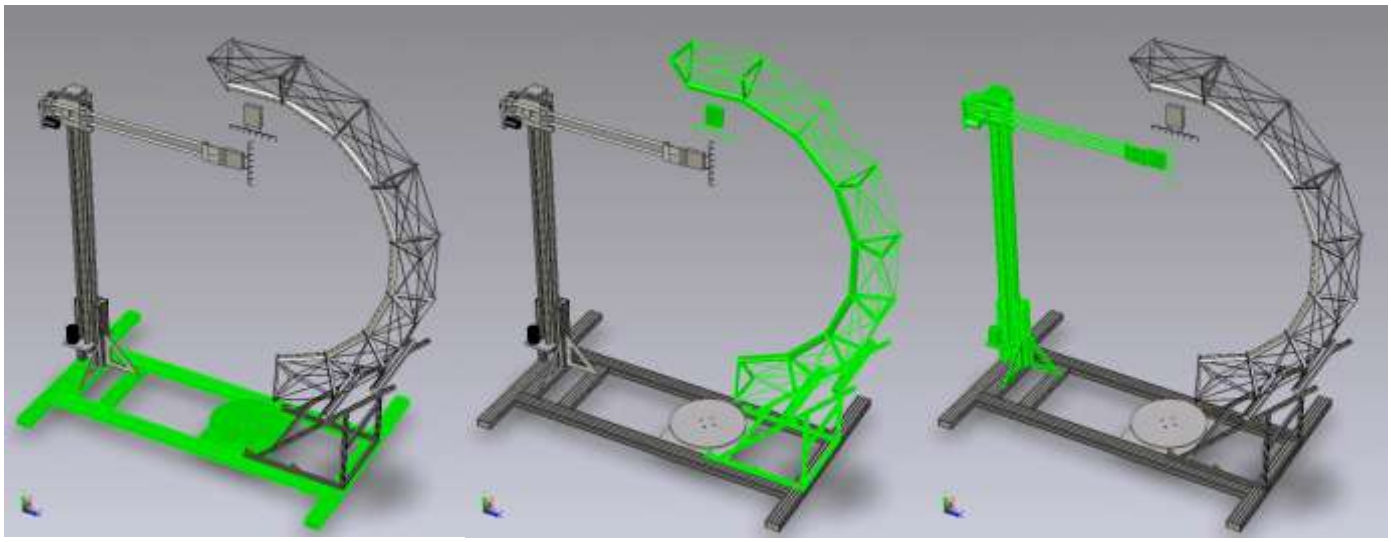
AMMAR is mostly symmetrical, but the motion control elements are oriented to one side, which shall be hereafter referred to as the "near" side. Facing the near side, the robotic tower and arm is on the left and the arc array truss is on the right.

Three Principal Physical Components

The robotic acoustic measurement system consists primarily of three main structural components:

1. Platform Base with Rotary Stage
2. Arc Array Truss with Truss-base and 8 Arc Array Structure Segments
3. Dynamic Position Apparatus with Pedestal, Vertical Robot Tower, and Horizontal Robot Arm

The platform base with the stage secured in the middle lies flat on the floor. The pedestal attaches at one end of the base, while the truss-base for the arc array structure attaches at the opposite end. The vertical robotic tower and horizontal robotic arm successively attach to the pedestal. The rotary stage is adjustable towards either end. The arc array structure consisting of 8 segments is secured to the truss-base.



Platform Base with Stage **Arc-Array Truss** **Robotic 2-Axis Arm**

Figure 1 – Principal Physical Components

80/20 Extruded Aluminum Elements

All three of these principal structural components comprise elements that include standardized extruded aluminum channel called "80/20". 80/20 is characterized by not only the extruded channel, but also T-nuts, Allen-drive button-head screws, gussets and brackets. 80/20 elements provide a foundation of flexibility for adjustment and future enhancements. The AMMAR assembly/disassembly plan attempts keep as much of the factory adjustment intact, as possible.

Almost all elements that are not 80/20 were custom-fabricated for AMMAR.

Figure 2 – AMMAR Structure

Physical Sub-Components

The other physical parts of the system and their locations are given in Table 1 and Table 2.

Table 1 – Passive Subcomponents

Item	Count	Location
Triangular supports	3	Secure the pedestal to the base.
Emergency stop switch	1	Conveniently located with a long cable which plugs into the motion control server.
Testing tripod	1	Temporarily positioned on subject stage when required.
Validation emitters	5	Attach at designated locations on pedestal, base siderails, truss arc segment, and testing tripod.

Table 2 – Active Subcomponents

Item	Count	Power	Location
Motion control servos	3	5VDC	Built-in to respective axis mechanisms.
Motion control server	1	110 VAC	Secures at the base of the pedestal.
Preamp modules with microphone array combs	9	5VDC	Attach to arc array segments and robotic hand.
MADI-ADAT converters (RME ADI-648)	2	110 VAC	Pre-affixed to the audio equipment rack within the truss-base.
Auxiliary power supply	1	110 VAC	Pre-affixed within the truss-base.
Emitter amplifier (Altec-Lansing)	1	110 VAC	Placed on top of audio equipment rack stack within the truss-base.
Host control digital audio workstation with KVM	1	110 VAC	Conveniently located away from the physical structure.

Accessories shipped with the system include extra motion control fuses and a tube of gel grease.

Tools

Tools required and furnished with the system toolkit (bag #8) include:

- 3/16” hex Allen wrench,
- 5/32” hex Allen wrench,
- 9/64” hex Allen wrench,
- 1/8” hex Allen wrench,
- 7/16” hex nut driver,
- 7/16” hex flat wrench, and
- 1/8” (small) slotted screwdriver.

Cables

Primary roles that cables perform in this system are given in Table 3.

Table 3 – Cable Descriptions

Cable role	Cable Type
AC Power	110 VAC power is supplied via standard IEC-C13 to NEMA-5 power cords for motion control server, host control digital audio processing unit, workstation monitor, and MADI-ADAT format converters. The auxiliary power supply utilizes a IEC C7 to NEMA-1 power cord. The emitter amplifier has a built-in NEMA-1 cord. The emitter amplifier, MADI-ADAT format converters, and auxiliary power supply all tie into a power strip integrated within the truss-base.
DC Power	5 VDC power is distributed to the motion servos and USBAD-ADAT preamp modules from two sources: motion control server and auxiliary power supply. The preamp modules obtain power through USB compatible cables. A plenum power cable with USB-B plugs distributes DC power on the truss arc array from the auxiliary power supply. The motion servos get power via the integrated multi-conductor cable to their respective axis.
Servo Encoder Signals	Integrated into the multi-conductor cable to their respective axis.
Servo Limit Signals	Integrated into the multi-conductor cable to their respective axis.
Digital Audio Data Signals	Two types of digital audio formats are utilized: ADAT and MADI. ADAT signal is distributed between the ADI-648 units and USBAD-ADAT modules via Toslink plastic fiber cables in a pre-configured bundle. There are two inbound signals (MAIN and AUX) and one outbound signal (SYNC) to each module. MADI signals are conveyed in two pairs from the DAPU to the ADI-648 units via either orange duplex SC glass fiber or RG-59 75-Ohm coax.
Digital Audio Clock Signals	Clock synchronization is distributed to the USBAD-ADAT modules via Toslink as described above. Clock synchronization between the DAPU and ADI-648 is conveyed upon the MADI cable described above. Clock synchronization between MADI interface cards is conveyed via a short RG-59 75-Ohm coax cable.
Analog Audio Signals	Analog signals from DAPU to emitter amplifier are via unbalanced stereo cables with TRS phone termination. Analog signals from amplifier to emitter are via unbalanced mono cables with TS phone termination.
External Control Signals	Control from the host control workstation to the motion control server is via Cat-5 ethernet cable, wired in cross-over.

Unpacking AMMAR

The system transports in five boxes:

- Crate 1 – Truss Box
  Wooden crate containing the truss-base with 2 pre-affixed RME ADI-648 units, 8 triangular segments of the truss arc structure, the motion control server, the emitter amplifier, the main workstation and monitor, the toolkit, and accessories.
- Crate 2 – Horizontal Box
  Wooden crate containing the horizontal axis arm.
- Crate 3 – Vertical Box
  Wooden crate containing the vertical axis tower.
- Crate 4 – Base box
  Wooden crate containing the base rails, the rotary stage, the tower foot, the arc-array foot, the pedestal, three triangular pedestal supports, five test signal emitters, and the Emergency Stop switch.
- Box 5 – Mic Array Box
  Cardboard box containing the 9 microphone array combs mounted on the black USBAD-ADAT modules.

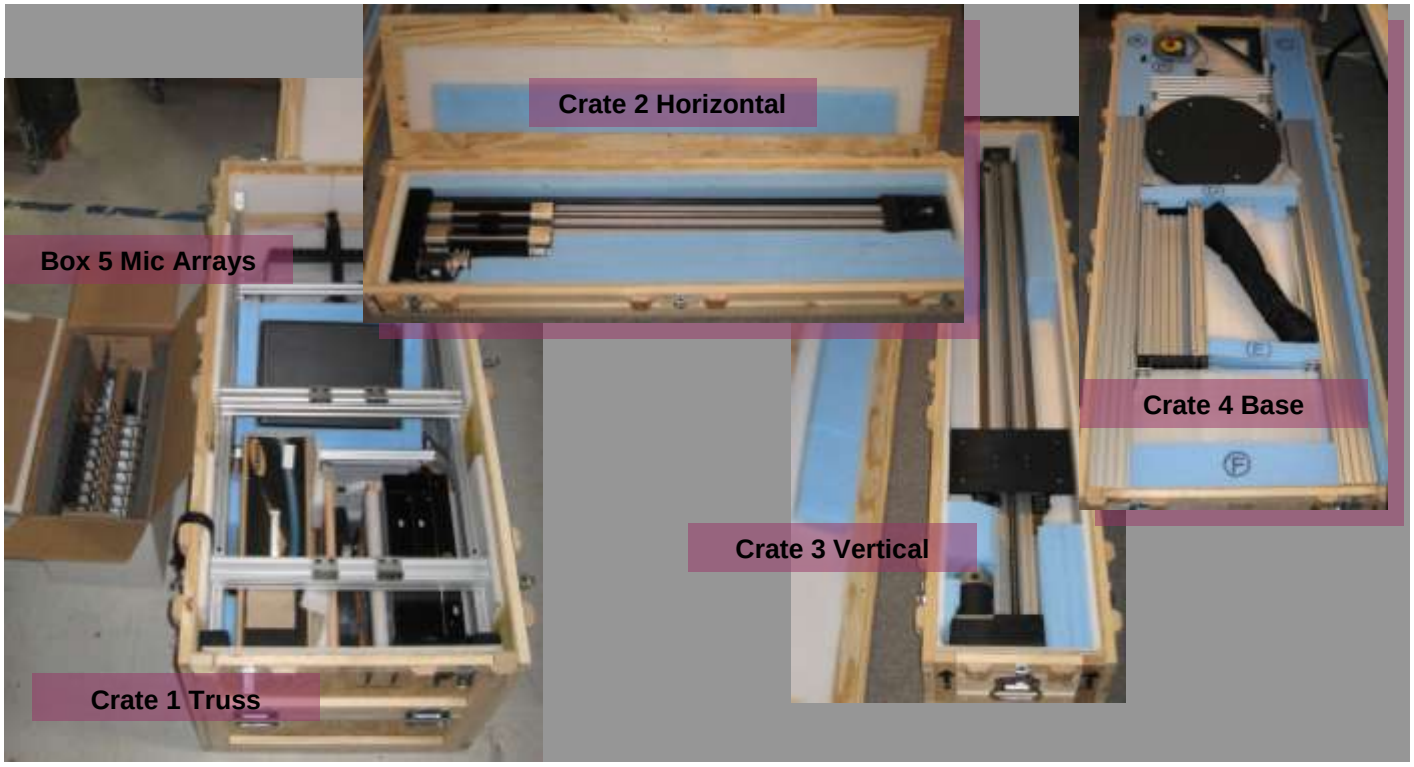


Figure 3 – Crate Designations

Hardware (tools, screws, and fasteners) is generally kept in place or contained in labeled plastic bags tabulated in Appendix H. The hardware bags are located in Crate 1.

Refer to the assembly sections below for crate unpacking. Unpacking items as needed is generally preferred. Essentially, unpacking and assembly will proceed in the following order:

1. Crate 4
2. Crate 3
3. Crate 2
4. Crate 1
5. Box 5

Unpacking Crate 1

Crate 1 is unique in that it contains items that will required at different points of the assembly process. It may be best to separate out a couple of items to make access to all items more direct as needed.

Open crate 1 as shown in Figure 4. Find and remove the keyboard and mouse box from within the truss base. Find the emitter amplifier nestled into a blue foam cradle within the truss base, resting on the MADI-ADAT converter stack. The cradle with amplifier can be removed by rotating it slightly, lifting, and setting it aside. Remove the truss base by lifting it straight up. Locate, remove, and organize the documentation package and 8 hardware bags.

Figure 4 – Packing of Crate 1

Remove and organize unattached cables from coiled cable chain bin between the DAPU and LCD monitor.

At this point all vital sub-components are accessible.

Assembling the Platform Base

Crate 4 is required for this step. Remove emergency stop button, tripod, pedestal, triangular supports, test-signal emitters, and labeled blue foam pieces from Crate 4. Set all aside. The pedestal and triangular supports will be used in this assembly section.

Hardware and fastener bags are found in Crate 1.

Platform Base

Extract from crate and lay the platform base (with integrated rotary stage) and feet flat on the floor as shown in Figure 5. The base with integrated rotary stage is heavy, requiring two able-bodied lifters. The tower foot is recognized with the integrated bracket and should be aligned with the tower end of the platform base, as shown in Figure 5.

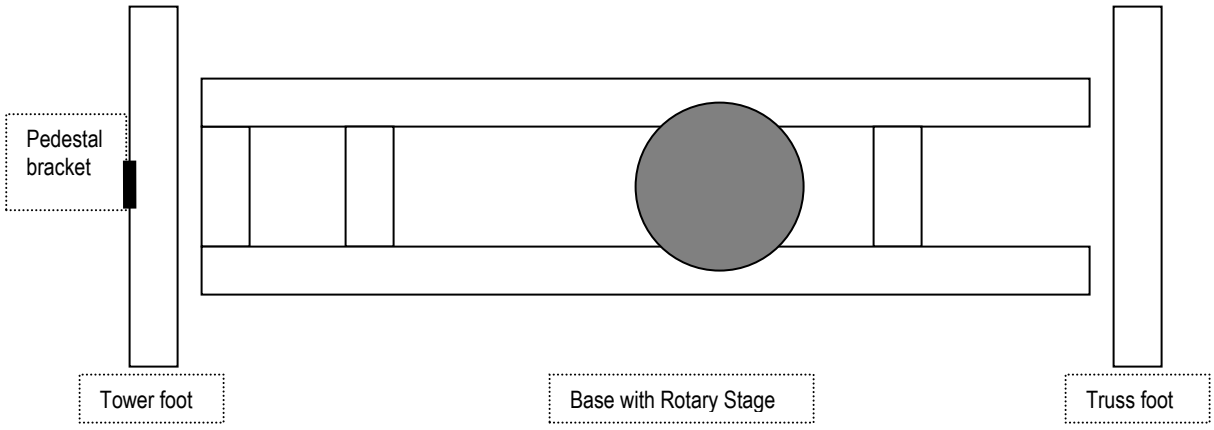


Figure 5 – Platform Base Foot Layout

The feet of the platform base are attached via right-angle brackets (see Figure 6). The right-angle brackets are factory-positioned on the feet, and secured, not be removed. The other side of the right-angle which attaches to the base contains screws and T-nuts that are loosened so that the T-nuts slide into the 80/20 channel of the base. Using a 5/32" Allen wrench, loosen the two designated dual T-nuts on each of the four right-angle brackets attached to the two feet by loosening the designated 16 screws by about 2 thread.

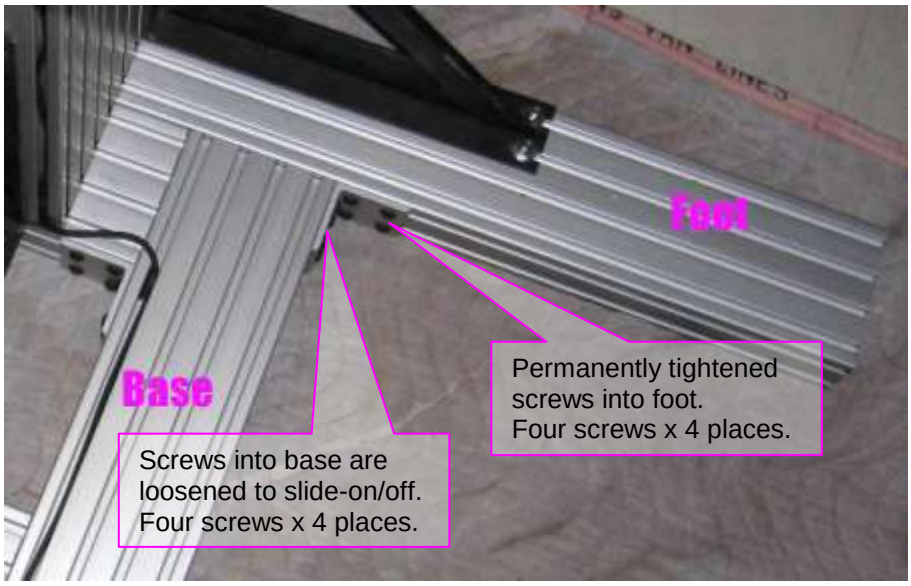


Figure 6 – Platform Base Feet Brackets

Carefully align, and slide the feet onto the base, so that the dual T-nuts on the right angle-brackets on the feet slide into the 80/20 channels in the base; tighten the screws on the black right-angle brackets as shown to secure the feet to the base:

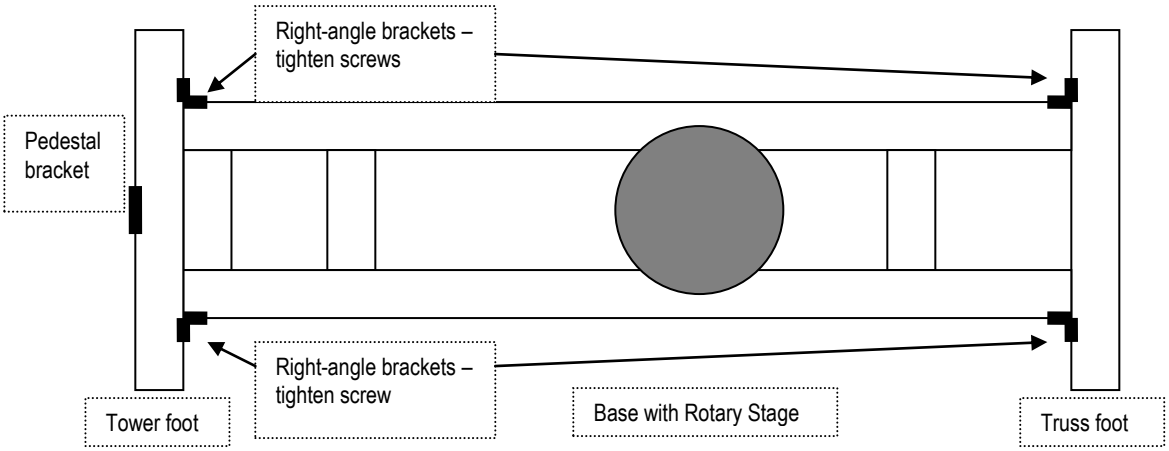


Figure 7 – Foot Attachment to Platform Base

Pedestal

Figure 8 - Assembled Pedestal with angle brackets

Insert pedestal rectangular dual-T-nuts (attachment hardware from "Bag 1: Pedestal To Base") in the grooves at the right side of the tower foot as shown in Figure 9, flat side up, and slide across to about the mid-point of the foot: Align both these T-nuts and the pair of T-nuts captured in the adjacent 80/20 segment, such that they are slightly to the right of the pedestal bracket.

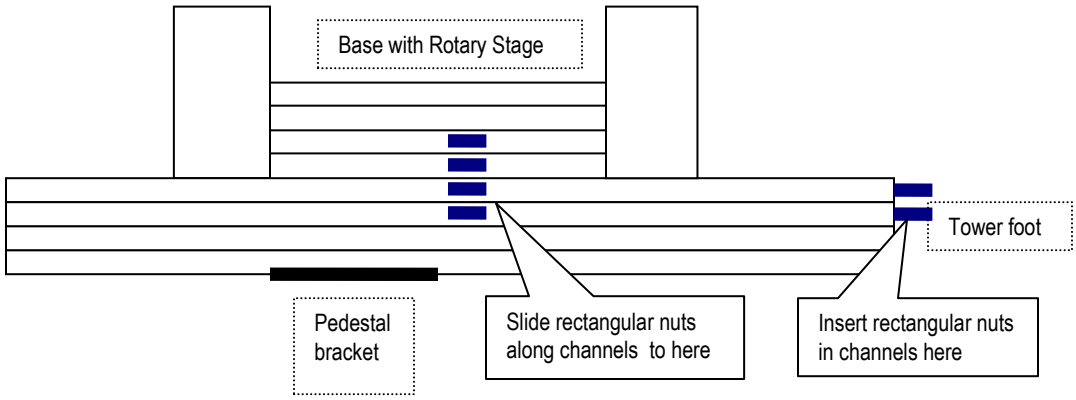


Figure 9 – Pedestal Attachment Preparation

Set the pedestal upright on the end of the platform base adjacent to the tower foot bracket as shown in Figure 10.

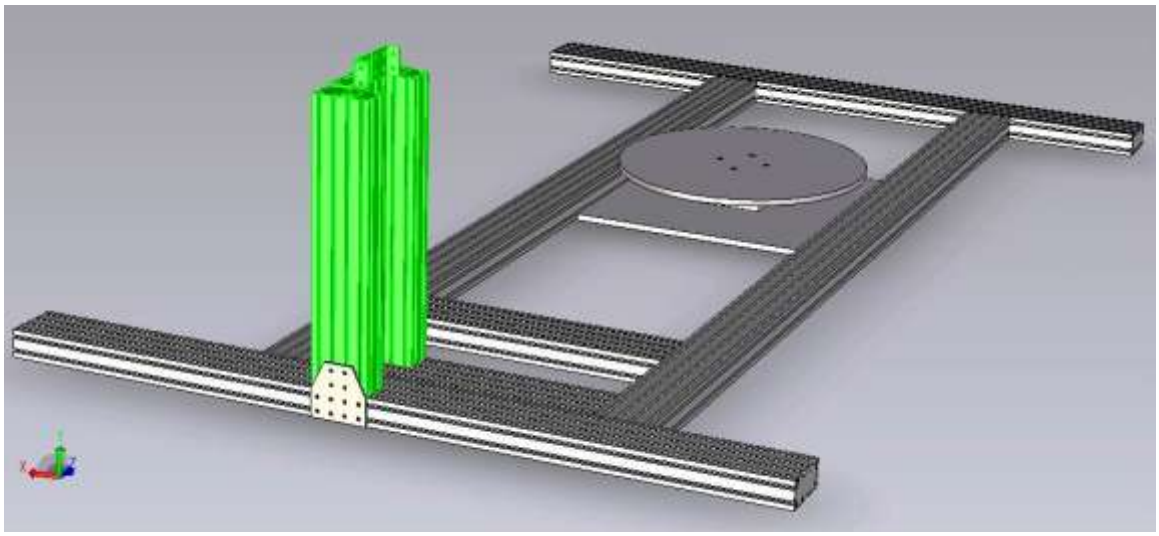


Figure 10 – Pedestal Attachment

Attach pedestal to base with 4 black 80/20 screws (Allen-drive button-head ¼”-20 x 3/8”) from “Bag 1 - Pedestal-to-Base” fastener bag through top half of bracket into T-nuts captured in the pedestal’s channels. Tighten the screws with 5/32” Allen wrench after inserting the cap-screws in the next step. The screws in the bottom of the bracket have been factory set to align the robot hand mic-array with the center of the stage. These should not be disturbed.

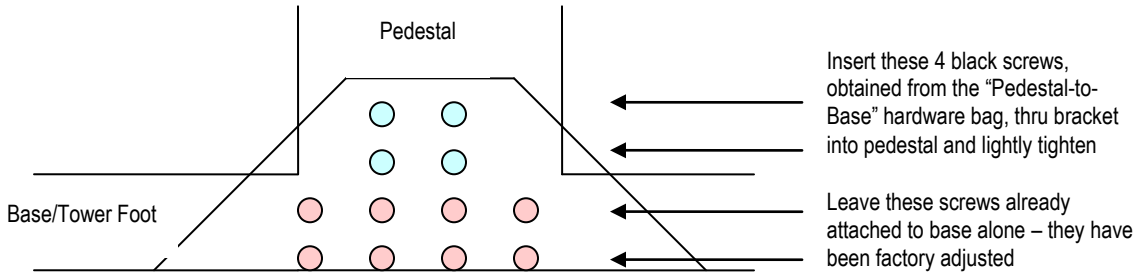


Figure 11 – Pedestal Bracket

Anchor the pedestal to the foot with 8 stainless-steel ¼”-20 x ½” cap-screws as shown in Figure 12. Before the cap-screws can be inserted, the T-nuts must be properly positioned in the channel below. The preparation step requested that the T-nuts be positioned so that they are visible after the pedestal is placed into position. Using the 3/16” hex Allen tool to reach into the channel, gently prod the T-nuts into aligned position under the pedestal.

Figure 12 – Pedestal Anchoring

Loosen the ¼”-20 hex-nuts on captured carriage bolts in the foot and pedestal, which can slide away from the pedestal-base joint. Remove ¼”-20 hex-nuts from carriage bolts embedded in platform base structure which cannot be slid away from the pedestal. One triangular support at a time, slide the carriage bolts in the channel such that the triangular support can be installed in respective corners as shown in . Slide the bolts back into the slots on the support ends.. Note that for the triangular support attaching to the tower foot, the required 2 carriage bolts, and their corresponding hex-nuts and washers will need to be retrieved from “Bag1: Pedestal To Base”, and slid into the appropriate tower foot channel. All other triangular support hardware should be captured within the the structure.

WARNING: Don’t tighten nuts too tight, as the steel nuts/bolts will bend the aluminum.

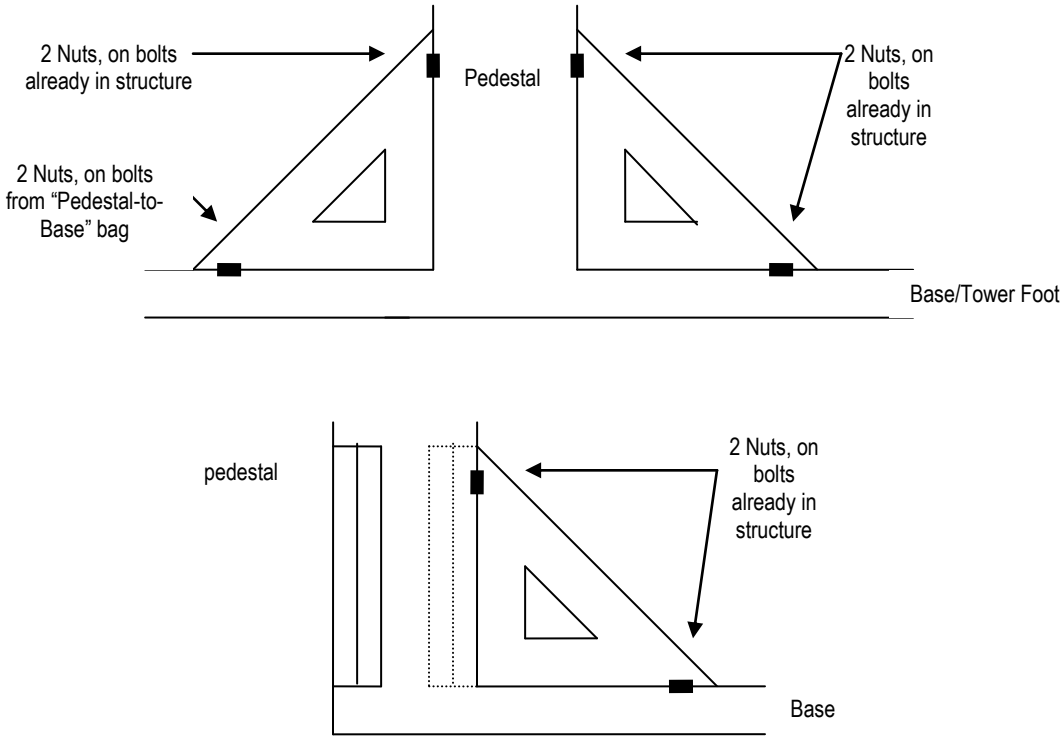


Figure 13 - Triangular Support hardware locations

It is best to tighten all pedestal security fasteners (pedestal bracket, pedestal anchor, and triangular supports) together, a bit at a time. Do not proceed to the next step until the pedestal is fully secured.

Assembling the Robotic Arm

Crates 2 and 3 are required for this step. Hardware and fastener bags are found in Crate 1.

Vertical Axis

From Crate 3, extract the vertical axis. The vertical axis is large, awkward, and heavy, and thus requires at least two able-bodied persons. From the crate it is best to first lift the

end opposite the servo motor slightly, then two people can lift the business end via the horizontal attachment plate. The side rails of the vertical axis are greased glides, and should be avoided from handling. The axis should never be lifted via the lead screw.

Mount vertical axis by holding axis vertically with the servo at the bottom and the back face (opposite the lead screw) towards the large pedestal channel. Use the horizontal attachment plate as a handle as necessary. Nestle the axis into the pedestal channel with the collar resting on top of the pedestal.

While one person supports the axis in place, insert the two ½" flat-head ¼"-20 screws into each side of the pedestal collar into the vertical axis collar. Insert eight 7/8" ¼"-20 cap-screws into the back side of the collar. Tighten all screws securely.

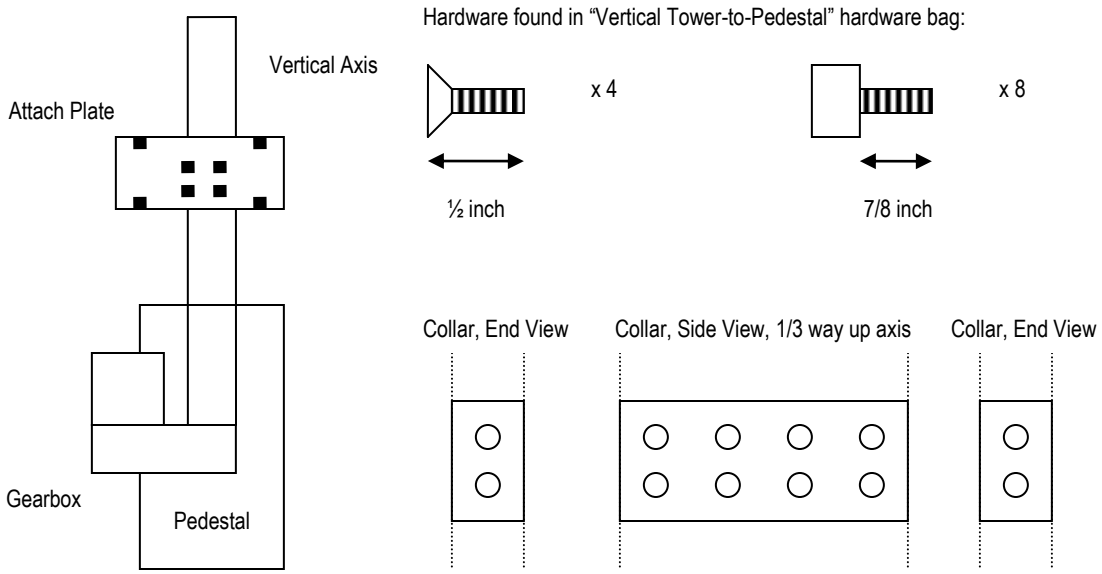


Figure 14 - Vertical Axis Attachment

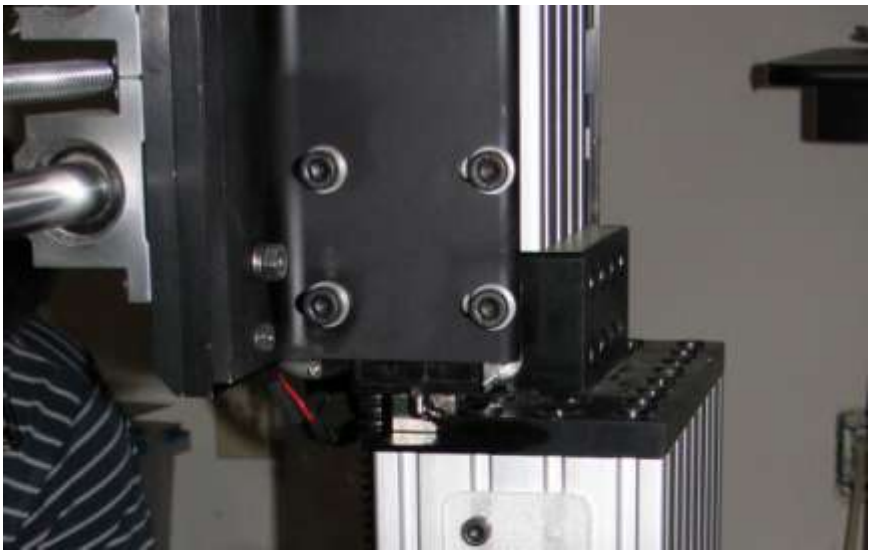


Figure 15 – Assembled Pedestal Collar

Horizontal Axis

From Crate 2, extract the horizontal axis. Although not as much as the vertical axis, the horizontal axis is still large, awkward, and heavy, and thus may be easier to wrestle with two able-bodied persons. From the crate it is best to first rotate axis by lifting the servo motor slightly. Please observe that there is a plastic sheet protecting the connectors at the bottom of the servo gear box. Remove the sheet once the axis is free from the crate. The axis should never be lifted via the lead screw.

Remove the nuts and washers to the four alignment pins on the horizontal mounting plate. Keep this hardware handy for securing the axis when it is mounted.

Align the horizontal axis mounting plate with the attachment plate on the vertical axis. Use the alignment pins captured in the horizontal mounting plate to engage the attachment. (See Figure 16) Secure the axis using 1/8" Allen wrench to hold alignment pin-bolts while the nuts with washers are hand-tightened onto their threaded end.

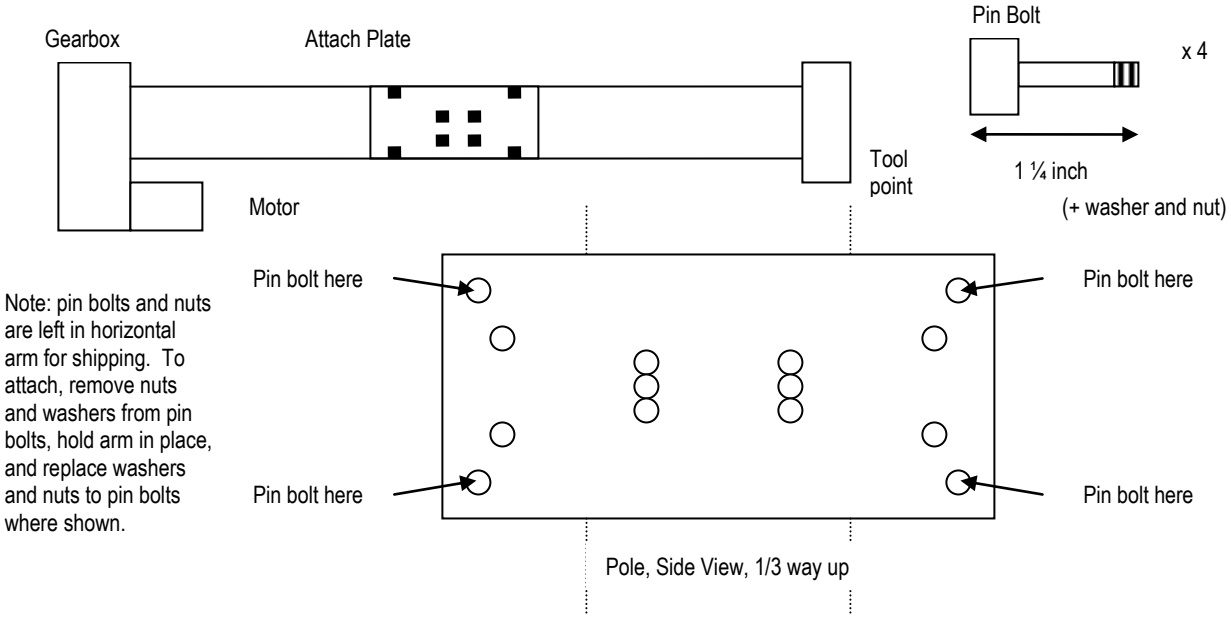


Figure 16 – Horizontal Axis Alignment Pin-bolt Locations

Motion Control Server (AMCS)

From Crate 1, find and extract the integrated power-supply and motion control server (AMCS) with attached coiled cable chain.

Remove the AMCS anchor screw from the tower foot as shown in Figure 17.

Position the AMCS such that its back is flush with the pedestal and its mounting flange hole is over the anchor nut in the 80/20 channel (see Figure 18 and Figure 20). Screw-down the AMCS with the screw removed earlier.

Figure 17 - AMCS Anchor Screw

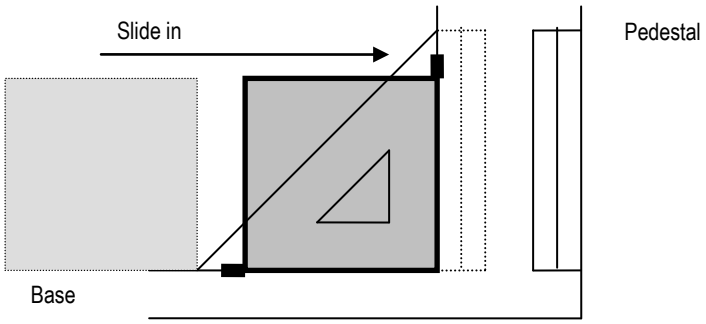


Figure 18 – AMCS Positioning

From the AMCS, please find the following cables emerging:

- Horizontal axis control and power cable chain
- Vertical axis control and power cable (rectangular connector)
- Stage axis control and power cable (double circular connectors)
- Three Toslink plastic fiber-optic cables

With the small, flat-head screwdriver, attach vertical axis cable to the connector in the vertical axis servo gear box (20-pin connector).

With small, flat-head screwdriver, attach the horizontal axis cable contained in the chain to the connector in the horizontal axis gear box (see Figure 19). Also remove the Toslink receptable covers from the bottom of the horizontal axis gear box, and connect the three fiber-optic cables within the chain to their designated receptacle.

Figure 19 – Horizontal axis gear box connections. Shown with Toslink covers in place.

Remove the aluminum protective cover under stage by removing accessible screw with 5/32" Allen wrench, sliding off the cover, attaching the cable's two connectors to their respective receptacles, replacing the cover, and then replacing the screw.

Feed bundle of 3 black fiber optic cables through the black conduit tube along the near side rail of the platform base, from the AMCS toward the truss. The ends of the fiber optic cable labeled 9S, 9M, and 9A will be connected to one of the ADI-648 units within the truss base later.

To the AMCS, attach:

- Power cable (from power outlet)
- Crossover Ethernet cable (from AMR client workstation)
- Emergency Stop cable (from Emergency Stop switch)

The installed AMCS should appear as show in Figure 20.

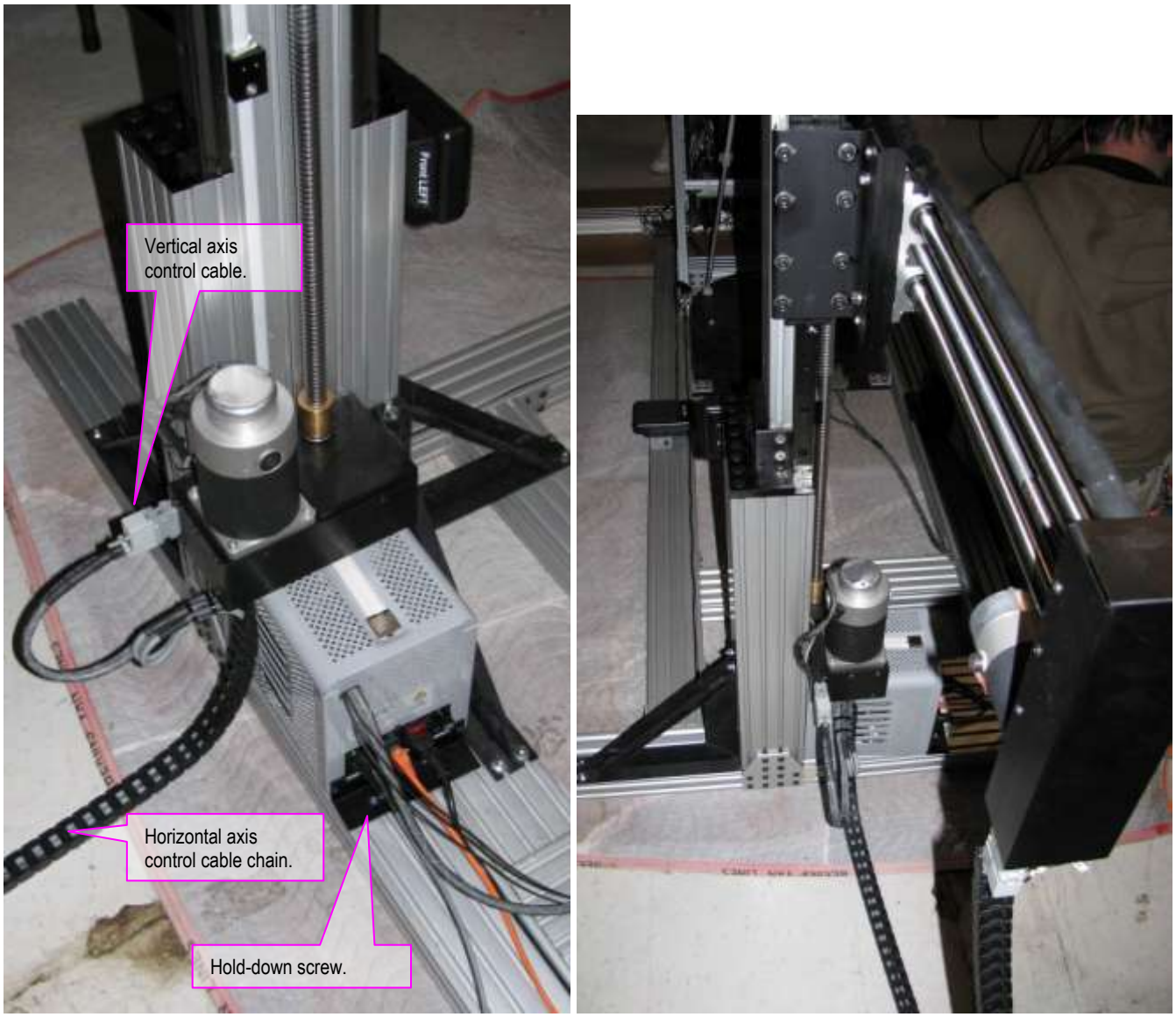


Figure 20 – Installed AMCS

Assembling the Mic Array Truss

The assembly of the arc array has four steps: truss-base, truss-arc-segments, mic-comb modules, and emitter amplifier.

Crate 1 is required for this section.

Attaching the Truss-Base

The aluminum microphone array truss-base, removed from crate 1 earlier, attaches on other end of the platform base as shown. Remove the 4 black T-handle nuts and their corresponding washers from their bolts constrained in the 80/20 channel of the platform base, and line up the remaining bolts in the channel with the holes on the mic array truss-base so that the truss-base can be lowered onto the base with the bolts protruding through the holes in the truss. After the truss-base is in place, replace the black T-handle nuts and their corresponding washers on the bolts and secure. The T-handle nuts will be tightened later when the truss is aligned with the stage rotation axis.

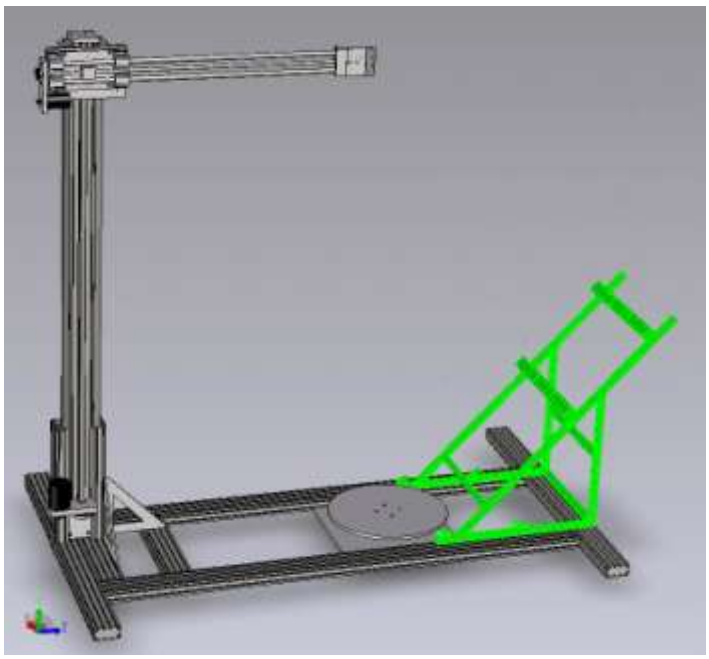


Figure 21 – Truss-Base on platform.

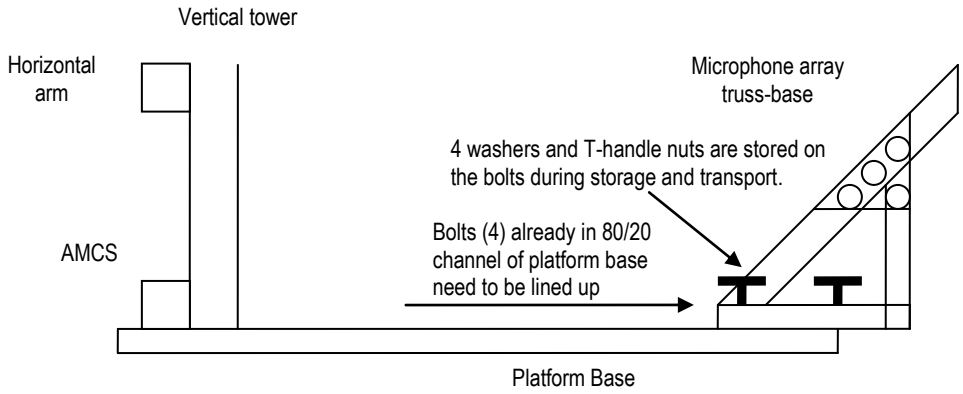


Figure 22 – Truss Base Positioning

Assembling the Truss Arc Segments

The truss segments are stacked with sandwiches of foam blankets between them and strapped down in one end of crate 1. Remove, separate, locate the segment numbers, and organize in order. Locate bag -3 with the arc-truss fasteners.

The truss segments were originally designed to be symmetrical and interchangeable. However, the fabricator altered the design, requiring the segments to be subsequently modified. Not all segments were similarly modified, thus making them position-specific. Most notably segment #2 has cross-bracing and special bolt holes very close to the dorsal tube. Segments #1 and #3 have holes specifically aligned with segment #2. The dorsal tube is in tension through these three segments, and thus the bolt needs to very close to the tube.

Foundation Segments Subassembly

Attach the black triangular truss arc segments to the aluminum truss as follows. First, connect black truss components 1, 2, and 3 to each other using two sets of 1" black cap-screw, washer, and wing-nut from the "Triangular Arc-Truss Segments" hardware bag-3 in each transition, only at the locations closest to the dorsal tube, as shown in Figure 23.

Figure 23 - Segments 1-2-3 sub-assembly.

Gusset Plate Mounting

It may be slightly easier to mount the USBAD mic-array gussets to the dorsal tube of each segment prior to mounting the segments on the truss, as a ladder may not be required. Locate Bag-4 "Gusset Plates to Arc-Truss", which contains both the gussets and the gusset fasteners. While the gussets can be mounted on the arc-array any way the researcher desires, the design for a 180-degree arc with 8 mic-arrays places one gusset centered on the dorsal tube of each segment. Find the hole alignment (2^{nd} and 4^{th} holes) that makes this work. At the factory, the arc-array mounting brackets on the truss-base were located to precisely line-up the transducers in the center of the stage. To keep that

precision, all of the gussets should be mounted on the right side of the dorsal tube as the observer faces the stage from behind the truss-base.

Figure 24 – Gusset Mounting on Arc Segment dorsal tube.

Use two ½" x ¼-20 bolts and nuts on each gusset, as shown in . Please note that the dorsal tube mounting holes are intentionally large to allow for positional fine-tuning. For a consistent starting point, pull the gusset away from dorsal tube tightly (hard against the outside of the hole), before securing the bolt.

Segment Mounting

Then mount this sub-assembly to the aluminum truss-base via the aluminum fixture-brackets, using two 1 ¼" black cap-screws, washers and hex nuts in each bracket, as shown in . Ensure that the orientation of truss segment #2 is as shown with the cross-bracing rising. For the remaining segments, if all segment labels are consistent with each other, then all segments will be proper. Finally, sequentially mount the remaining truss segments 4 through 8 in continuation from segment #3[1]. Use four sets of 1" cap-screw, washer, and wing nut on each interface.

[1] Other arc configurations may be valid as long as the segment interfaces where the dorsal tube is in tension involve segments 1, 2, 3, or 8.

Figure 25 - Segment 2 mounted on truss-base.

Figure 26 - Segments mounted at top of arc.

Mounting Mic Combs/Preamp Modules

The nine USBAD pre-amplifier modules with their attached mic-arrays are packed together in box 5. For best handling, unpack them as they are mounted. To unpack box 5,

- Open the lid
- Pull the hold-down-tube retainer board "Tube-Lock"
- Slide the hold-down-tube out the end of the box to release the mic-arrays.

Locate Bag 6 "USBAD Modules to Arc-Truss" to find the cap-screws and washers for fastening the modules to the gussets.

Figure 27 - Remove Tube-Lock

Mount the black USBAD modules with integrated mic-arrays to gussets on truss segments as shown in Figure 28. Please note that the gussets provide to adjustable slots and a center fixed hole. Using the fixed hole provides the precise geometry for evenly distributed transducers.

Figure 28 - USBAD mic-array mounting on gusset.

Upon the last factory calibration, the modules were distributed such that the best-calibrated mic-array/module pairs were on the robotic hand and in the center of the arc-array. The distribution is given in Table 4 below.

Table 4 - Module Locations

Mount Location	Mic Array ID	Pre-Amp ID
Segment 1	8	909
Segment 2	7	912
Segment 3	14	908
Segment 4	13	907
Segment 5	16	910
Segment 6	2	904
Segment 7	4	902
Segment 8	5	903
Robotic Hand	3	901

Seating the Emitter Amplifier

Locate the emitter amplifier set aside when Crate 1 was initially unpacked. Remove from blue-foam nesting box. Place the amplifier (Altec-Lansing LS3251) on top of the ADI-648 units with the front face towards the near side of the AMMAR appartus, as shown in Figure 29. And plug its power cord into the power strip that is attached to the truss-base.

Figure 29 - Amplifier Location within truss-base.

Emitter Amplifier Remote Control

Mounting the Emitters

Attach the loudspeakers/emitters to the structure according to the table below. The four fixed-position emitters all attach with 2 black ¼"-20 cap screws (requires 3/16" hex Allen wrench) from bag #6, labeled "Emitter to Apparatus". Run each cable back to the amplifier neatly in an 8020 extrusion channel where applicable. This prevents entanglement, especially around the robotic stage. Use the black retainers at key points to keep the cable secured in the channels. Plug in each speaker's ¼" TS phone plug to the corresponding jack on the amplifier.

Table 5 – Emitter Locations

Label	Amp Chnl	Fastener	Attachment Location
Pedestal	Front LEFT	¼"-20 x 3/8" cap screw (2)	Pedestal, facing the truss
ArcArray	Front RIGHT	¼"-20 x ¾" cap screw (2)	Truss arc segment #4, facing pedestal
Rail NEAR	Srnd LEFT	¼"-20 x 3/8" cap screw (2)	Near base rail, facing up
Rail FAR	Srnd RIGHT	¼"-20 x 3/8" cap screw (2)	Far base rail, facing up
Stage	Center	Clip adaptor	Tripod, wedge clip adaptor

Workstation

Set up the workstation processing unit, keyboard, mouse, and monitor in a chosen location. For initial use, proximity to the apparatus is highly advantageous. The furnished analog audio cable is only 3 meters long. Remote the workstation only after the AMMAR system has become familiar.

Cabling

USBAD Harness

Thread the fiber optic cable bundle through the black triangular truss components with the longest cables, labeled 8S-8M-8A at the top within truss component 8. Plug the cable terminations within each black triangular truss components into the USBAD port as specified in Table 6.

Table 6 – USBAD Harness

Cable Label	Port	Device Location
1M	"Main"	USBAD Truss Segment 1
1A	"Aux"	
1S	"XCLK"	
2M	"Main"	USBAD Truss Segment 2
2A	"Aux"	
2S	"XCLK"	
3M	"Main"	USBAD Truss Segment 3
3A	"Aux"	
3S	"XCLK"	
4M	"Main"	USBAD Truss Segment 4
4A	"Aux"	
4S	"XCLK"	
5M	"Main"	USBAD Truss Segment 5
5A	"Aux"	
5S	"XCLK"	
6M	"Main"	USBAD Truss Segment 6
6A	"Aux"	
6S	"XCLK"	
7M	"Main"	USBAD Truss Segment 7
7A	"Aux"	
7S	"XCLK"	
8M	"Main"	USBAD Truss Segment 8
8A	"Aux"	
8S	"XCLK"	
9M	"Main"	Robot wrist mounted USBAD
9A	"Aux"	
9S	"XCLK"	

Connect the inbound end of the fiber optic cables in the cable bundle to the ADI-648 units as given in Table 7 and Table 8.

Table 7 – 48 kHz ADAT Distribution

ADI-648 - Top unit								
ADAT Output Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:	8S	7S	6S	5S	4S	3S	2S	1S
ADAT Input Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:	8M	7M	6M	5M	4M	3M	2M	1M
ADI-648 - Bottom unit								
ADAT Output Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:								9S
ADAT Input Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:	8A	7A	6A	5A	4A	3A	9A	9M

Table 8 - 96 kHz ADAT Distribution

ADI-648 - Top unit								
ADAT Output Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:		4S		3S		2S		1S
ADAT Input Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:	4A	4M	3A	3M	2A	2M	1A	1M
ADI-648 - Bottom unit								
ADAT Output Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:		8S		7S		6S		5S
ADAT Input Port Numbers:	8	7	6	5	4	3	2	1
Cable Labels:	8A	8M	7A	7M	6A	6M	5A	5M

Locate the black power cable with a round silver connector on one end and beige breakout cables labeled “1Pwr”, “2Pwr”, “3Pwr”, etc. on the other. Thread the power cable bundle through the black triangular truss components with the longest breakout cable, labeled “8Pwr” at the top within truss component 8. Plug the round silver connector into the round port attached to the aluminum truss, about 12” off the ground. Plug the cable terminations within each black triangular truss components into the USBAD port as specified in the table below:

Table 9 – USBAD Power Distribution

Cable Label	Port	Device Location
1Pwr	“USB”	USBAD Truss Segment 1
2Pwr	“USB”	USBAD Truss Segment 2
3Pwr	“USB”	USBAD Truss Segment 3
4Pwr	“USB”	USBAD Truss Segment 4
5Pwr	“USB”	USBAD Truss Segment 5
6Pwr	“USB”	USBAD Truss Segment 6
7Pwr	“USB”	USBAD Truss Segment 7
8Pwr	“USB”	USBAD Truss Segment 8

Workstation

Make the following workstation cable connections:

- Connect the keyboard with integrated pointing device to the workstation by plugging the purple keyboard cable connector into the keyboard port on the back of the workstation, and plugging the green pointing device cable connector into the mouse port on the back of the workstation.
- Connect the monitor to the workstation by plugging using the supplied DVI cable, plugging one end into the LCD monitor, and the other end into the DVI port on the workstation video expansion card.
- Connect the workstation to an external network/Internet by plugging an external network cable into the 100-BaseT port on the back of the workstation that is next to the 1394 “Firewire” port.

- Connect the workstation to the motion control server by plugging a Cat-5 “crossover” cable into the 100-BaseT port on the back of the workstation that is on the expansion card next to the MADI cards, and the other end into the 100-BaseT port on the motion control server.
- To provide synchronization of the two MADI devices using the supplied short BNC cable, connect the “WC-OUT” port on the “MADI-1” card to the “WC-IN” port on the “MADI-2” card.

Workstation to Array

- Connect the workstation’s first MADI card, labeled “MADI-1”, to the top ADI-648 unit using one of the supplied orange fiber optic cables. Plug the connector labeled “A1” into the top optical port of “MADI-1”; plug the connector labeled “B1” into the bottom optical port of “MADI-1”; plug the connector labeled “A2” into the optical port of the top ADI-648 unit labeled “In”; and plug the connector labeled “B2” into the optical port of the top ADI-648 unit labeled “Out”.
- Similarly, connect the workstation’s second MADI card, labeled “MADI-2”, to the bottom ADI-648 unit using the other supplied orange fiber optic cable. Plug the connector labeled “A1” into the top optical port of “MADI-2”; plug the connector labeled “B1” into the bottom optical port of “MADI-2”; plug the connector labeled “A2” into the optical port of the bottom ADI-648 unit labeled “In”; and plug the connector labeled “B2” into the optical port of the bottom ADI-648 unit labeled “Out”.
- To provide output to the speaker amplifier, connect an analog audio cable with stereo plugs to the “Analog” port on “MADI-1” card, and the other end to the “Front” port on the “Audio 1.5 Input” area of the amplifier.

Power

Audio Distribution System

Attach the beige power cord from the power strip to a power source.

AMCS

Standard 120V AC power powers the AMCS via a single standard power cable. The AMCS distributes the DC power to the other components through integrated cabling.

Workstation

- Provide power to the monitor by plugging one end of the monitor power cable into the monitor power port and the other into a live power source.
- Provide the workstation with power by plugging one end of the workstation power cable into the workstation power port and the other into a live power source.

Initial Power Up

Safety

Prior to any power-up, the full apparatus and connections should be carefully double-checked. The system includes robotic mechanisms which have safety features, but the ultimate responsibility falls to the operator. The operator should carefully examine the operation envelope to ensure that the robotic axes can translate in their full motion without interference. No person should be allowed to enter the proximity of the robot without being aware the robot is active and the operator being aware of his or her activity.

Please refer to the Quick Start Guide in AMMARDocGuide.pdf and to the AMR_OperationManual.pdf for more details on safety.

Audio Distribution System

The power-strip mounted in the truss-base controls power to all devices at that end of the apparatus. Switch on this strip first. The eight microphone-preamps on the arc-array should all come alive as soon as strip power is applied, with two lighted LED's. The other components in the audio distribution stack in the truss-base have additional power switches described below.

MADI-ADAT Converters (RME 648)

The RME ADI-648 units respectively have a power switch on their front right side. There is no harm in leaving this switch ON and controlling power at the power strip.

Emitter Amplifier (Altec-Lansing LS3251)

The Altec-Lansing Amplifier has a power switch on its back panel. There is no harm in leaving this switch ON and controlling power at the power strip.

Advanced Motion Control Server (AMCS)

Power System

The motion control server contains two separate power supplies: the main power supply, which provides power to the embedded computer, and the servo power supply, which provides power to the servo motors actuate all the motion of the system. A single power switch on the system controls the main power supply, while power to the servo motors must be triggered in software by a call from the control application on the workstation, such as EasyMotion, amrGUI, amrInit, or a user-written application.

There is also a single fuse protecting the entire power system. If no there is no red backlight to the power switch when engaged and known external power is supplied, likely the fuse may be blown. Try replacing the fuse on the motion control server. Extra fuses are supplied.

LED's on Power System

There are three LED's on the motion control server which report the status of the main components of the power system:

1. Leftmost/green: main 5V power supply on/off
2. Middle/amber: Transformer on/off
3. Rightmost/green: servo amps on/off

The leftmost green LED should react only to the main power switch, while the other two LED's should react to the control application.

Host Control Digital Audio Workstation