

Project A.R.E.S User Manual

All-terrain Robotic Excavation System

Florida Institute of Technology's
NASA Robotic Mining Competition 2016
Team Entry

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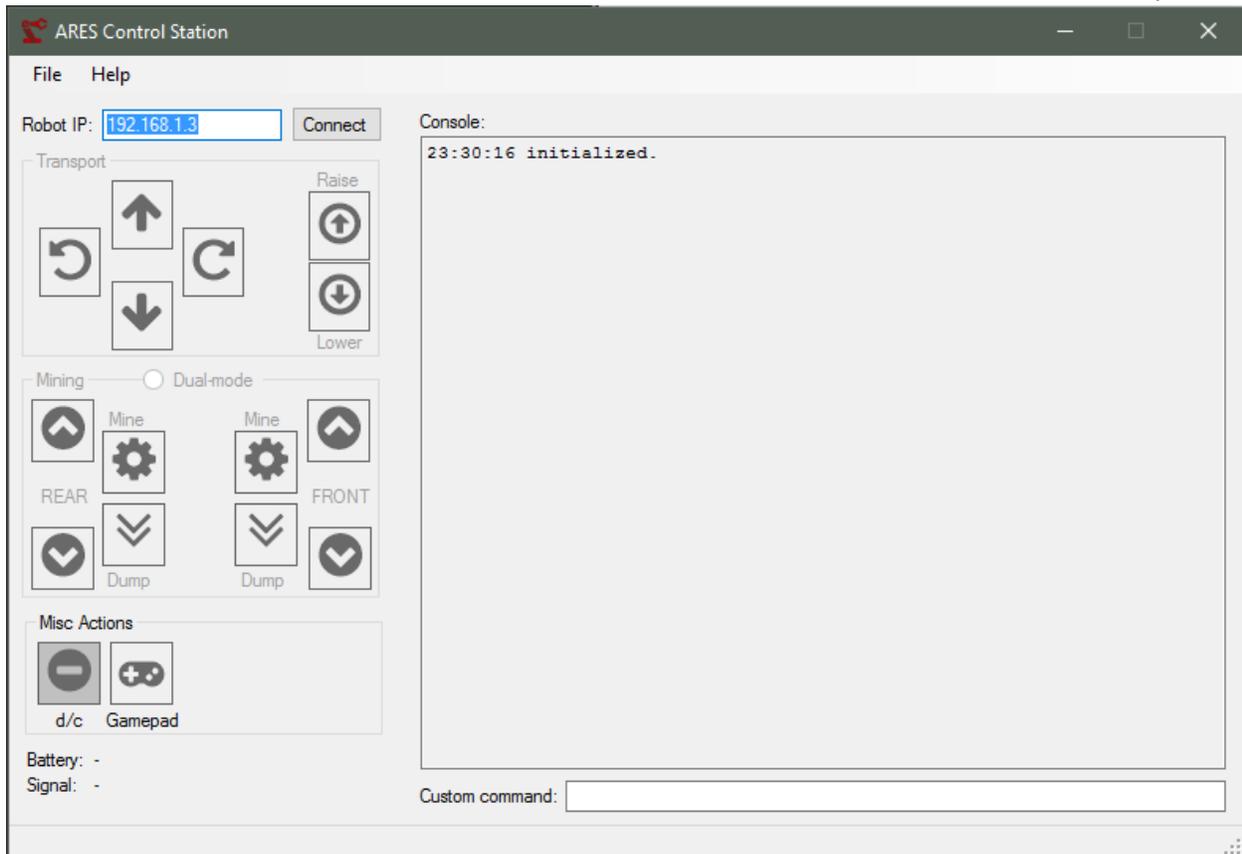
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Introduction

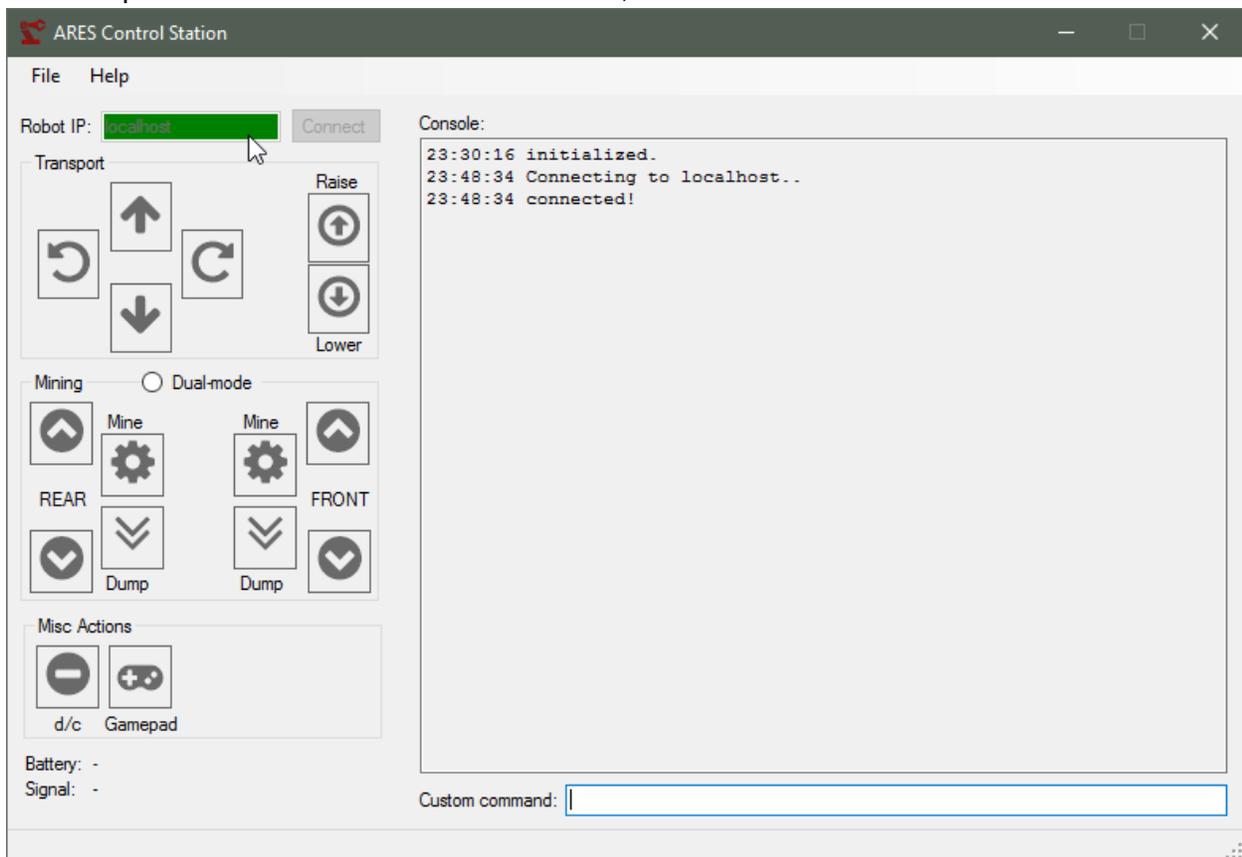
ARES was designed to be as user-friendly as possible from the very beginning. We took a lot of the experience and lessons-learned from the Robotic Mining Competition in 2015 and applied it to this year's design to avoid some of the pitfalls that were previously encountered. Firstly, the user interface has been designed such that even an inexperienced operator is able to control the robot with relative ease. Secondly, the method of control for the robot is flexible. The buttons can be used, or a Playstation 4 controller can be used. And finally, the system is intended to work out of the box and with minimal interaction aside from the initial connection and actual robot control. This document aims to help users familiarize themselves with the ARES control system.

Getting Started

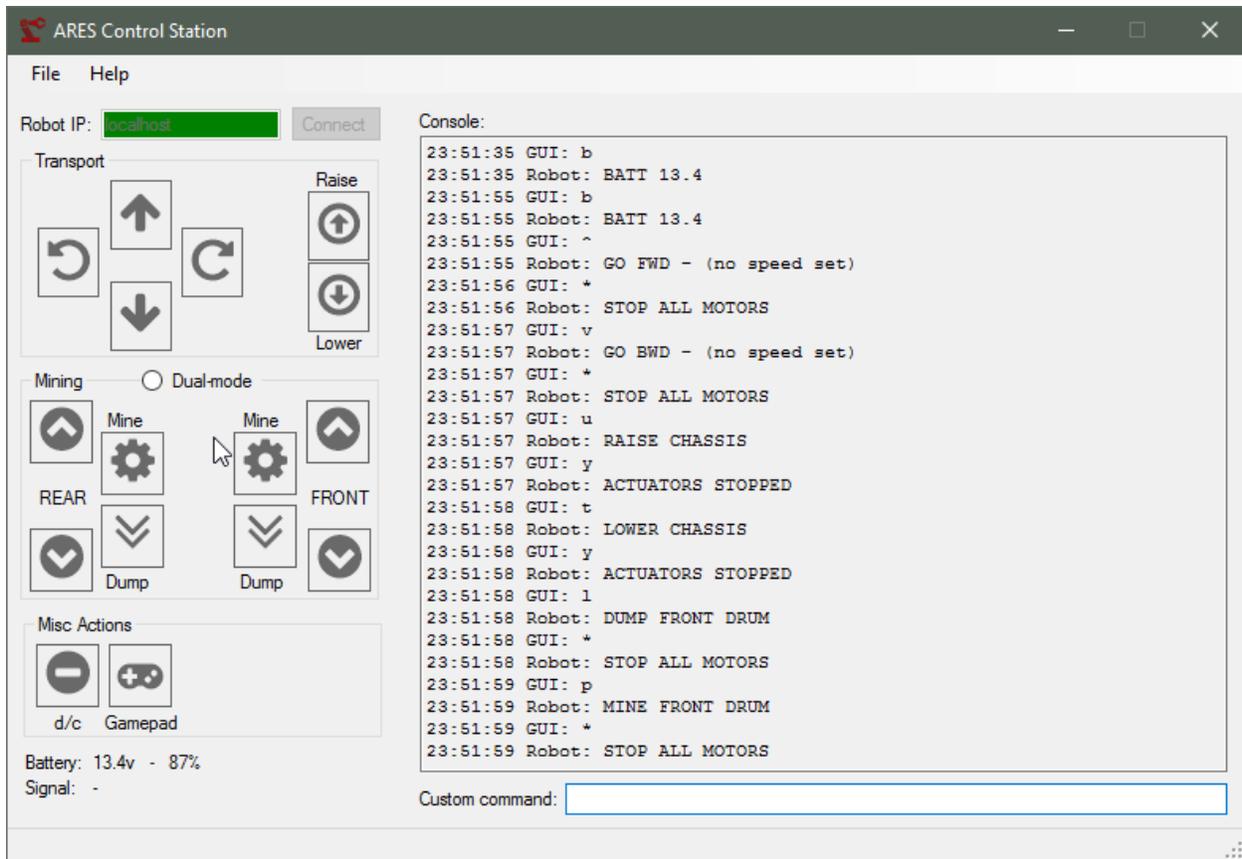
- Firstly, the robot control software needs to be downloaded and installed. For that, please see <http://pa.blocanse.co/nasarmc> and click on the **Download Latest Build** link to download the necessary files.
- Unzip the files to your favorite location on your hard drive.
- Double-click **ControlStation.exe** to start the user interface. This window comes up.



- Connect your laptop to the same network as the robot. The robot is set to automatically connect to a network called **FITRMC**. It's a good idea for this network to be isolated from the internet, but not a deal-breaker. The rest of this document assumes you're connected to the same network as the robot, and that the network has the SSID (network name) **FITRMC**.
- Now we can begin startup on the robot itself. The ARES robot can be turned on by taking the large red emergency stop button (E_STOP) and twisting it clockwise to release it outwards. *Note: this is the same button that must be pressed to kill battery power.*
- After a short wait, a yellow LED on the top of the robot will light up. **This means the robot is ready to be controlled.**
- By default, the robot will have the IP address **192.168.1.3** so click the connect button. Upon successful connection to the robot, the control interface will look like this:



- That's basically it! From here, you can begin by clicking the various buttons in the **Transport** or **Mining** button groups and see the robot come to life:



The Gamepad Button

You may have noticed by now the button that looks like a video game controller. This button makes it so you can control the ARES robot with a commercially available Playstation 4 controller. It's suspected that other controllers work as well, but only the Playstation 4 controller is officially supported.

First, plug in a Playstation 4 to the computer the ARES control software is running on with a micro USB cable. Then, press the **Gamepad** button. That's it! You can now control ARES with your Playstation 4 controller. Below is a table with gamepad buttons and their actions:

L1	Turn counter clockwise
L2	Drive in reverse
R1	Turn clockwise
R2	Drive forward
▲ Triangle	Raise robot chassis (with actuators)

X Cross	Lower robot chassis (with actuators)
O Circle	Halt all motors
■ Square	Unimplemented
Share Button	End gamepad control
Left Stick Y >50% or <-50%	Raise and lower rear excavation drum
Right Stick Y >50% or <-50%	Raise and lower front excavation drum
Left Stick X >50% or <-50%	Mine and dump with rear excavation drum
Right Stick X >50% or <-50%	Mine and dump with front excavation drum

The Dual-mode Toggle

This one's pretty simple. If it's toggled, any action taken with the rear or front mining apparatus will also be applied to the opposing mining apparatus. The includes raising, lowering, mining and dumping. If the toggle is unset, the mining apparatus will go back to independent mutually exclusive control.

The D/C Button

This button simply disconnects the control software from the robot. At this point, the robot will go back to a waiting connection state and the LED on the unit will turn on once more.

The Battery and Signal Indicators

Battery will return the voltage of the battery and what percentage battery life you have left assuming a full battery voltage of 13.8 (as tested during development via multimeter attached to a fully charged battery). Signal is... well.. your wifi signal strength as a percentage.

Custom Commands

All capabilities of the ARES control software are basically just single characters sent over the network. As a result, whenever a button is pressed or a gamepad interaction happens, a corresponding single character is sent to the robot via WIFI (or ethernet) if available. There's

also a custom command field under the console on the main screen. You can enter these characters there and they will be executed as expected. Here's a list of them and what they do.

- ^ 4 Drive forward at specified speed (1 through 5) (don't forget the space)
- v 3 Drive in reverse at specified speed (1 through 5) (don't forget the space)
- < Turn counter clockwise
- > Turn clockwise
- u Raise robot chassis
- y Halt actuators
- t Lower robot chassis
- * Halt all motors
- b Refresh battery level
- s Refresh Wifi Signal Strength
- c Raise rear excavation drum
- f Lower rear excavation drum
- o Excavate with rear drum
- k Dump with rear drum
- z Raise front excavation drum
- x Lower front excavation drum
- p Mine with front drum
- l Drump with front drum
- - Immediately halt the robot's on-board software

Additional Notes

The robot's on-board software can be interacted with over SSH. The IP address of the robot is **192.168.1.3** by default when connected to the **FITRMC** network. The default username is **pi** and the password is **raspberry**. Typical SSH clients include Putty and OpenSSH, both have been tested and work with the ARES control software. Continue on once you're successfully connected to the robot via SSH.

To update the on-board software, just type **stop** and press enter twice. You should see **Python3: no process found**. This is a successful indicator that the software is no longer running and is safe to update. Now type **update** and press enter. The robot will fetch the latest code from Github at <http://github.com/pmcanseco/ares>. It will do this automatically. *Note that this requires access to the internet and won't work in an isolated network.*

After a successful update, the software can be ran again with the **run** command. Just type **run** and press enter and it will start up. You will also be able to see the robot's side of the software and what it outputs. It's safe to simply close the SSH session as everything will still be left running in the background.