	Mars Rover Design Team	Team Continuum	Cornell Mars Rover	ITU Rover Team	UWRT Robotics	Ryerson Rams Robotics (R3)	SJSU Robotics	Team Anveshak
School Name	Missouri University of Science and Technology	University of Wroclaw, Poland	Cornell University, USA	Istanbul Technical University, Turkey	University of Waterloo, Canada	Ryerson University, Canada	San Jose State University, USA	Indian Institute of Technology, Madras
Final Score (Rank)	403.4 **(1)**	336.3 (2)	264.1 (11)	243.1 (13)	225.7 (15)	190.9 (21)	164.3 (26)	151.4 (29)
Wireless radios and antennas 	Ubiquiti 900MHz, Cloverleaf MIMO antenna on rover and dual polarity yagi at base station	Ubiquiti Bullet	Base station antenna was the Ubiquiti AM-2G15-120, rover antenna was the Super Power Supply B00O7ZEK7S, rover and base transceiver was the Ubiquiti Rocket M2	Microhard pDDL2450 could achieve 1km in non-line of sight with 5 dBi omnidirectional antennas. We also backed up comms except the cameras and the TCP link via a RF link with 433 MHz LoRa module.	2.4 GHz and 900 MHz antennas	Ubiquiti M2 Rockets 2.4GHz 802.11n MIMO paired with TP-Link 2408CL omnidirectional antennas	Ubiquiti Rockets M900 and the directional Ubiquiti Loco M900	TP-Link WA 5210 2.4GHz with included directional antenna
Battery System 	LGChem18650HE4 Lithium Ion, 80 set up in custom pack, 10 set in parallel with 8 of those sets in series	Custom LiPo modules	1x MaxAmps 7S LIPO Battery	Tattu 6 cell LiPo 22Ah	1x Tattu 6 cell 22Ah Tattu LiPo	Panasonic NCR18650BD 3.7V 3200mAh Li-Ion 4 batteries in series to achieve 14.8V and 6 in parallel to achieve a 19.2Ah	3x Zippy LiPos 7S with a power board we designed	3x 24V LiPo batteries for drive, 2x 12V LiPo batteries for auger/arm
Wired Communication Protocols 	I2C, RS232, RoveComm (Custom UDP)	CAN built-into the bananapi with two networks, one for driving wheels, another for the manipulator	CAN bus for interboard, UART for Intel NUC to microcontrollers	I2C for sensors, USB for Raspberry Pi to microcontrollers	CAN for most things, USB for drive motor controller, I2C/SPI for sensors	I2C sensors, USB for cameras, USB serial for Arduinos, UART for GPS, PWM for motor controllers	I2C, UART, Bluetooth (RFCOMM), SPI, PWM, PPM	Serial from the main computer to the various Arduinos
Sensor Fusion 	Kalman filtering and custom filtering	robot_ localization	robot_ localization	robot_ localization, custom EKF backup in microcontrollers	robot_ localization	robot_ localization, didn't end up using due to IMU issues	None	None
Team Strengths 	Manufacturing capabilities and access to programs that allow us to have many custom components on our rover.	Drive and manipulator controls. Also, I think being just 10 people ups our motivation a lot. Everyone has important work to do	Modularity	Our wireless communication modules. We never lost control or communication to our rover at the competition.	A lot of different experiences from team members because of our coop program.	Tmux for terminal organization, keeping things simple, team dedication, and keeping it fun.	The absolute passion from each and every member of our team as well as our team manage system.	Dedicated team, always ready to learn new things, not shy of challenges. We made great strides in learning ROS in a matter of 3 months.
Improvements for next year 	Fix bugs and flaws we found while at URC 2017 and push the boundaries of innovation as we build a new rover.	More field tests of the whole Rover.	Ease of use: easy way to launch and monitor the entire system. Live sensor diagnostics and robust CV.	I really want to add machine learning for finding the tennis ball from further.	Improve our project management.	Clearly labelled wires and pin outs, avoid USB hubs, and a geologist team member.	Secure bigger budget, start earlier, and update our technologies.	More development time, exploit ROS even more, test things more often, more collaboration with other teams.
Source code git	github.com/mst-mrdt	Inverse kinematics only gist.github.com/danielsnider/5181ca50cef0ec8fdea5c11279a9fdbc	https://drive.google.com/open?id=0B1r9QYTd8YNrWXNjNmdtcGlwMjQ	github.com/itu-rover	github.com/uwrobotics	github.com/teamr3/URC	github.com/kammce/RoverCore-S	github.com/Team-Anveshak/rover-control