

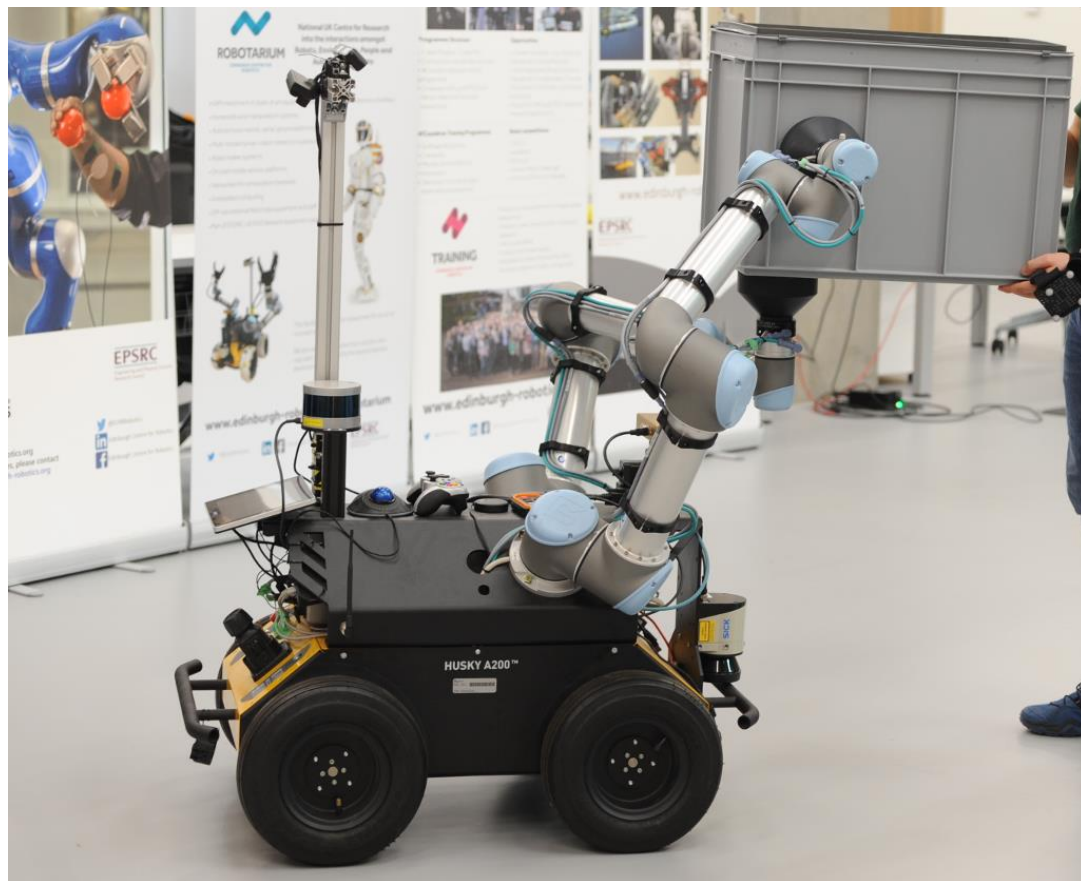


## Dual Arm Husky Risk Assessment Form

School Assessment No:	INFRA 53
Title of Activity:	Working with the Husky robot
Location(s) of Work:	Field Robotics Lab; Bayes G.7

**Brief Description of Work:**

Working with the Husky robot for navigation, manipulation, and sensing.



**Hazard Identification:**

<b>Hazard(s)</b>	<b>Present Risk Evaluation</b> L/M/H	<b>Control Measures</b> (i.e., alternative work methods / mechanical aids / engineering controls, etc.)	<b>Risk Evaluation after control</b> L/M/H
<b>Damage caused by inexperienced user</b>	H	<b>No user is allowed to operate the robot without having completely read and understood the HUSKY operation manual, completed an induction session with an experienced and trained user, read and signed with countersignature this Risk Assessment form, or following the safety procedures described herein.</b>	L
Impact between robot and people or objects in its path (e.g., being struck by the robotic arm)	L	<p>Only authorised and trained operators may work with the robot. This is a 2-man operation.</p> <p><b>The emergency STOP button must be always within easy reach of the operator.</b></p> <p>The operators should be familiar with safe code of working practice for working with the robot. The robot's control software uses a 'dead-man's trigger' i.e., the controller must continuously transmit to the robot to give the robot 'permission' to move. Otherwise, the robot will come to an immediate halt. Operators will be familiar with how this</p>	L

		<p>work and that by simply releasing their finger from the button commanding the robot, the robot will stop moving.</p> <p>When not being actively tested the robot's immobilizing button must always be pressed. Otherwise, the remote controller must be always within the reach of the operator.</p>	
<p>Crushing and trapping (e.g., part of the body being trapped between the robotic arm joints)</p>	<p>H</p>	<p>Those working in close proximity to the robot should be aware of areas of possible injury, such as around the wheels and between the moving links of the robot arms.</p> <p>The robot is mobile, and care must be always taken when it is operational to ensure people are kept outside its driving path and outside of the robot's working envelope.</p> <p>Operators should ensure they do not get trapped between robot and other surfaces.</p> <p>All bystanders should be kept away from the area of operation.</p> <p>One of the operators should always be watching the robot and prepared to issue warnings or stop the unit if the risk of injury is imminent.</p> <p>Do not operate the robot near areas with</p>	<p>L</p>

		<p>unprotected sudden height drops (e.g., steps), where it may topple/fall on bystanders.</p> <p>When not being actively tested the robot's immobilizing button must always be pressed. Otherwise, the remote controller must be always within the reach of the operator.</p> <p><b>The emergency STOP button must be always within easy reach of the operator.</b></p>	
Slipping/tripping/toppling	L	<p>The robot must not be driving on slopes steeper than 15° to prevent toppling. The high centre of mass and overall mass distribution must be considered when executing arm motion and driving over sloped and uneven terrain. Extra care should be taken when taking turns on a sloped surface.</p> <p>Working areas should be kept clear of obstructions.</p> <p>Any spillages should be cleaned up immediately.</p> <p>Any hazards such as trailing cables, defects to floors coverings, faulty lighting etc. should be reported immediately to the Admin Office / Local Safety Adviser or another senior member of staff.</p>	L

<p>Electrical equipment (electrocution)</p>	<p>M</p>	<p>All portable electrical equipment must be safety tested at correct intervals and labelled with the date of test.</p> <p>Any defective equipment should be reported immediately to the Admin Office / Local Safety Adviser or another member of senior staff, then suitably labelled and taken out of use until the repair has been effected.</p> <p>The robot uses Li-Ion batteries. The batteries must be regularly charged and discharged to ensure a long battery life.</p> <p>The battery can be disconnected for transport by removing the dummy connector. This must be done in a safe and dry environment to prevent short circuiting the power connectors. The procedure is detailed in the user manual must be followed and the battery cover must be closed before the robot is powered up.</p> <p>The robot can also be operated using shore power. This must be done in safe and dry environment. The procedure is detailed in the user manual must be followed. The robot must not be driving when the shore power is connected.</p>	<p>L</p>
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		<p>Only use of the sensors and the arms is allowed.</p> <p>The robot must be fully powered down before replacing the battery or connecting the shore power.</p>	
Fire	H	<p>The robot uses Li-Ion batteries which must be charged using the provided charger and the proper charging procedure must be followed.</p> <p>Lab users must be acquainted with the Fire Routine Procedure for the area.</p>	L
Lifting of unit (back injuries)	H	<p>At times it is useful to lift the robot from its wheels during testing. The vehicle can be manually lifted by 2 people and placed on a box. The robot must be fully shut down and the arms must be parked away from the carrying handles before lifting. The immobilizing button must be pressed, and the arms disengaged.</p> <p>Follow procedures for heavy and bulky loads that present a risk of injury.</p>	L

**Engineering Controls:**

Guarding		Extraction (LEV)		Interlocks		Enclosure	
Other relevant information (incl. testing frequency if appropriate):							

**Personal Protective Equipment (PPE):**

Eye / Face		Hand /Arm		Feet / Legs		Respiratory	
Body (clothing)		Hearing		Other (Specify)			
Specify the grade(s) of PPE to be worn:							
Specify when during the activity the item(s) of PPE must be worn:							

**Non-disposable items of PPE must be inspected regularly, and records retained for inspection**

Persons at Risk:

Academic staff	X	Technical staff	X	P'Grad students	X	U'Grad students	X
Maintenance staff	X	Office staff		Cleaning staff		Emergency personnel	
Contractors		Visitors	X	Others			

**Additional Information:**

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Assessment carried out by:

Name:	Vladimir Ivan	Date:	25/08/2021
Signature:		Review Date:	25/08/2022



## Safe system of work – Form SSW

### Working with the Dual Arm Husky robot – INFRA 53

INFRA 12 must be read, understood, and signed off along with this SSW, before use of the robot inside of the robotics labs.

INFRA 02 must be read, understood, and signed off along with this SSW, before use of the robot outside of the robotics labs.

**No user is allowed to operate the robot without having completely read and understood the Husky operation manual, completed an induction session with an experienced and trained user, read and signed with countersignature this Risk Assessment form or following the safety procedures described herein.**

The robot start-up procedure is described in the user manual. When using the arms, the sequence of turning on the arms is important (refer to the manual). Use the screen and trackball to control the arm controllers. The screen switches between the two controllers using the button on its side. The screen is NOT a touch screen.

The Husky is a mobile robot weighing about 90kgs and can move at 0.5m/s. All operation should be carried out by a team of no less than 2 people, with at least one being an authorised experienced user.

Do not operate the robot within 1m of any unblocked drop-off (step, floor edge, etc.).

Inexperienced **\*or\*** unauthorised use is not allowed. When performing experiments/demonstrations including inexperienced personnel, ensure they are aware of the robot's working envelope, weight, and speed. Ensure there is a safety gap or barrier, enabling the operator to stop the robot in case of an emergency.

Before use, the area should be checked and cleared of unnecessary items. Cables should be neatly routed, and the emergency stop button available for use and the operator should carry the remote controller and always follow the robot closely.

If any injury occurs, the unit should be stopped, disabled and medical assistance sought.

Once finished: the Wireless Emergency Stop must be pressed, all processes stopped on the robot, arms parked, then execute the arm shutdown procedure in the correct order, wait for the shutdown while monitoring the screen, then shut down the base.

The emergency phone number is 2222. The nearest First Aid box is in the floor kitchen. Informatics First Aider list can be found on the web at;

<http://www.inf.ed.ac.uk/safety/first-aiders.html>



### Verification by users

Sign below to indicate you have read and understood the safe system of work.

<b>Working with the Dual Arm Husky robot – INFRA 53</b>	
Signature:	Date: