



KINOVA Gen2 Risk Assessment Form

School Assessment No:	INFRA 54
Title of Activity:	Operating the KINOVA Gen2 robotic arm.
Location(s) of Work:	Field Robotics Lab; Bayes Centre G.7

Brief Description of Work:

Experimental work with the robotic arm.



Hazard Identification:

Hazard(s)	Present Risk Evaluation L/M/H	Control Measures (i.e., alternative work methods / mechanical aids / engineering controls, etc.)	Risk Evaluation after control L/M/H
Impact between robotic arm and people or objects in its path (e.g., being struck by the robotic arm)	L	<p>The KINOVA Gen2 robot is designed to allow human-robot close proximity, however only authorised and trained operators may work within the working envelope.</p> <p>The emergency STOP button must be always within easy reach of the operator. When the arm is mounted on another robot, the emergency stop of that robot must be within the operators reach at all times.</p> <p>The operators should be familiar with safe code of working practice for working with the robot.</p> <p>No unauthorised person should enter the robot's working envelope when robot operation is underway, unless an authorised and trained operator is present attending control of the robot.</p> <p>No unauthorised person should operate the robot.</p> <p>Because of null space motion, the robot's elbow can move quite a lot during Cartesian control. This is because the robot is trying to avoid singularities and angle limits while trying to keep a preferred angle position and without modifying the user's Cartesian command.</p>	L

Crushing and trapping (e.g. part of the body being trapped between the robotic arm and the fixed object)	L	<p>Those working in close proximity to the robot should be aware of areas of possible injury, such as the small gaps in rotational joints.</p> <p>The emergency STOP button must be always within easy reach of the operator. When the arm is mounted on another robot, the emergency stop of that robot must be within the operators reach at all times.</p>	L
Ejection of the workpiece from the grippers due to mechanical failure, malfunction or overloading.	L	<p>The emergency STOP button must be always within easy reach of the operator. When the arm is mounted on another robot, the the emergency stop of that robot must be within the operators reach at all times.</p>	L
Electric Shock	M	<p>All portable electrical equipment must be safety tested at correct intervals and labelled with the date of test.</p> <p>Electrical cables, plugs should be regularly visually inspected by the user for damage.</p> <p>To prevent risk of fire or electric shock, avoid overloading wall outlets and extension cords. Protect the cords from being walked on or pinched.</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>Any computer hardware faults should be reported to members of computing staff.</p>	L

		<p>Repairs and maintenance of the equipment can only be carried out by qualified engineers or technical staff.</p> <p>The robot must be powered down and unplugged before performing any modifications or maintenance.</p> <p>The control port and power connector are intended to be connected only with a Kinova-approved device. Connecting other devices may result in poor performance, make the arm inoperable and void your warranty.</p> <p>Do not override the safety purpose of the polarized or grounding-type plug. If the provided cable does not fit your outlet, consult an electrician for replacement of the obsolete outlet.</p> <p>When mounting the arm on another robot, make sure that the battery respects the electrical specifications of the arm.</p> <p>Make sure to connect your end effector using only pins 19 and/or 20. Using other pins could severely damage your robot.</p>	
Slipping/tripping	L	<p>The working area should be free of trip hazards.</p> <p>Any spillages should be cleaned up immediately.</p> <p>Do not immerse any part of the robot under water or snow.</p>	L
Mounting and moving the unit (tripping/toppling)	M	<p>The robot must be mounted on a strong surface with enough weight and suitable mass</p>	M

		<p>distribution to prevent the robot and the desk from toppling. Alternatively, the arm can be mounted on another robot in which case the mass distribution of the combined system must be considered.</p> <p>Before moving the robot arm from the pedestal, it must be powered down, and all cables must be disconnected according to the manufacturer's instructions.</p> <p>The robot arm must be transported inside the padded transport case provided by the manufacturer.</p>	
Fire and overheating	L	<p>This equipment is not designed to be used in presence of flammable mixture. (Not AP or APG rated). Do not install the robot near any heat sources, such as radiators. Do not use it to directly manipulate hot objects.</p>	

Engineering Controls:

Guarding	X	Extraction (LEV)		Interlocks		Enclosure	
Other relevant information (incl. testing frequency if appropriate):							
Guarding by separation of people from the robot's working envelope.							

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:

Authorisation and training are required prior to the use of the robotic arm.

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 Kinova Gen2 robot – INFRA 54

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

No user is allowed to operate the robot without having 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.

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

NEVER carry out any changes or adjustments to the robot when it is powered up.

Before operating the robot, please make sure it is properly installed.

The robotic arm must not be overloaded. The robot was not designed to act as a lift. It is not recommended to use the robot under heavy rain or snow conditions.

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 keep the Emergency Stop within reach at all times.

Never use the HOME/RETRACTED function when carrying liquid. The HOME position is pre-set, and the wrist may rotate and drop the liquid. Do not manipulate cutting, very sharp, or any dangerous tools or objects with the robot. Do not force the fingers beyond their maximal opening. This could damage some internal components.

Position and velocity control:

Self-collisions are not automatically avoided during angular control. Only joint limits are handled. If you give a command and the robot stops moving because it is too close to a protection zone, try moving the robot in another direction.

Protection zones are not avoided during angular control. Only joint limits are handled.

Admittance control:

In Cartesian admittance mode, you should grab the robot by its hand when you interact with it. If you grab it by another link (e.g., grab the robot at elbow level), the admittance will still work, but the hand might rotate in an unusual way. If you have the impression that the robot is moving unusually in admittance mode, please check your torque sensor calibration.

Torque control:

Please note that when the robot is in torque mode, it is NOT possible to move the robot's fingers. When in torque control mode, do not disable the velocity safety feature unless you are sure that your robot's torque sensors are well calibrated.

Be very careful when you disable a torque control safety feature. Ideally, keep the robot in an open environment free of near potential obstacles. Please keep in mind that commanding your robot in torque mode with safeties disabled could damage your robot if the motors start turning too fast or if the robot collides with itself or the environment. If you disable the base collision avoidance safety, keep in mind that the robot could collide with itself. A lot of safety parameters are customizable in torque mode (see the HTML based API documentation in the SDK for more details) but be aware that these customizations require knowledge to use appropriately.

Moving the robot very quickly in torque mode can lead, in rare occasions, to an unexpected reboot - the robot stops moving or switches back to position mode and waits for a Home/Ready command. If you observe this behaviour, please contact the Kinova Support team (see Contacting Support).

Maintenance:

Do not wash more than three times per day. The product is not intended to be sterile. No sterilization process should be undertaken with the product. Do not rub the external surfaces with abrasive materials.

Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, for example if the power-supply cord or plug is damaged, if the product does not operate normally or if it has been dropped.

The product has no user serviceable parts. Do not open. Do not modify equipment without the authorization of the manufacturer.

When lifting weight near the maximum load and reach, if the red lights of the controller blink, put down the object in the gripper, bring back the robot to HOME or RETRACTED position and wait until the warning goes away before using it again.

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

Should any defects in the equipment be spotted, they must be reported to the Supervisor and the use of the machine suspended until corrective action has been taken.

Once finished: shut down the robot according to the user manual. When the power is turned off, the robot will fall down and may cause damage to itself, depending on its position at the time of disconnection. Be sure to support its wrist before turning the power off.

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>

