



TALOS Robot Risk Assessment Form

School Assessment No:	INFRA 57
Title of Activity:	Operating the TALOS humanoid robot
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
Damage caused by inexperienced user	H	No user is allowed to operate the robot without having completely read and understood the TALOS 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.	L
Impact between the robot and people or objects in its path (e.g., being struck by the robotic arm)	M	Always maintain a safe distance between the robot and the operator. The operator must be outside the kinematic reach of the robot and with the safety button in hand.	L
Crushing and trapping (e.g., part of the body being trapped between the robotic arm joints)	H	Since the operator must be placed at a safe distance of the robot while operating it there is no risk of being trapped. If it is required to interact with the robot, the manual explains the prohibited parts that should not be touched because of potential pinching: grippers, ankle bar, first joint of the arm.	L
Loss of balance/Slipping or tipping during robot motion	H	The robot should always be operated with a safety crane, so that in case of a fall the robot will hang from the safety ropes and risk of impact with the ground and operators will be largely reduced. The robot may fall down at any time. There is no mechanism that can enforce balance constraints for	L

		<p>all operating conditions, particularly when:</p> <ul style="list-style-type: none"> • the emergency stop is activated • the robot is externally disturbed (e.g: it is pushed or hits an obstacle) • the operator sends control commands that make the robot lose balance • the robot steps on an uneven surface while walking. 	
Electrical equipment (electrocution)	M	<p>There is no electrical hazard when operating the robot if there is no disassembly of any of its parts.</p> <p>An anti-static heel grounder should be used to reduce the risk of electro-static discharge.</p> <p>The manual and the safe system of work document explains how to operate the battery of the robot in a safe manner.</p>	L
Fire	M	<p>The robot is designed to be operated indoor and ambient temperature between +10 and +35 degrees Celsius.</p> <p>The robot is equipped with several sensors that continuously monitor temperature of critical components: motors, integrated circuits, battery. Electrical short circuits will be isolated by protection fuses, preventing operating the robot in case of power supply issues.</p> <p>C Class or ABC Class fire extinguisher should be used in case of fire. (Powder)</p>	L
Lifting of unit (back injuries)	H	<p>The robot must always be operated with a lifting crane.</p>	L

Created on: 23/9/19

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:

Authorisation and training are required prior to the use of the humanoid robot.

A powder-based fire extinguisher must be available locally

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 TALOS humanoid robot – INFRA 57

INFRA 12 and INFRA XX 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.

The hardware and software of TALOS allows users to research and develop activities in the following areas:

- Biped walking
- Navigation and SLAM
- Manipulation, grasping, whole body control
- Speech recognition
- Computer vision
- Human-robot interaction

Strictly prohibited uses include:

- Applications that require the robot to be used without the crane.
- Manipulating objects exceeding the payload specifications of the arms
- Modifications of the robot's hardware in any way without prior and appropriate instruction by PAL Robotics.
- Applications where the robot could cause harm either to people or to itself.
- Operation by untrained staff.

Working environment and usage guidelines

The working temperatures are:

- Robot: +10 °C ~ +35 °C

- Basestation: -5 °C ~ +55 °C (ambient with air flow)

The space where TALOS operates should have a hazards free floor. Stairways and other drop-off points can pose an extreme danger. Avoid hazardous or sharp objects (such as knives), sources of fire, hazardous chemicals or furniture that could be knocked over.

The terrain for TALOS's usage must be capable of supporting the weight of the robot (see Section Specifications in robot's handbook). It should be horizontal and flat. Do not use carpets that are not attached to the surface under them to avoid the robot tripping over.

Make sure the robot has adequate space for any expected or unexpected operation.

Make sure the environment is free of objects that could pose a risk if knocked, hit, or otherwise affected by TALOS.

Make sure there are no cables or ropes that could be caught in the covers, legs, or arms, as these could pull other objects over.

Keep animals away from the robot.

Be aware of emergency exit locations and ensure they cannot be blocked by the robot.

Do not operate the robot outdoors.

Keep TALOS away from flames and other sources of heat.

Do not allow the robot to come into contact with liquids.

Keep the room clear of dust.

Avoid the use or presence of magnetic devices near the robot.

Be cautious whenever the robots' arms are away from the body, as body parts or other objects could be damaged if caught between the body and the arms.

Apply extreme caution with children.

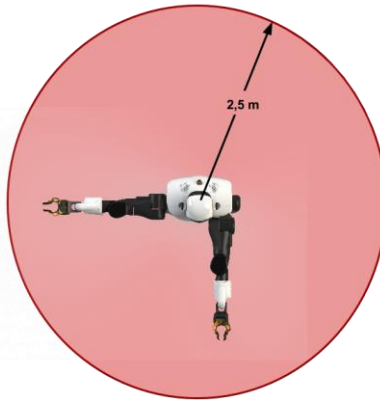
Risks

1. The robot can cause significant damage if it runs over someone or if someone runs over it. The robot can wield dangerous implements and can knock heavy objects over. People must always be cautious and attentive when around a TALOS .

2. The behaviour and capabilities of TALOS can be changed by user interaction or reprogramming.

Safety distance

In order to keep both the robot and operators safe while TALOS is working, everyone except authorized personnel should maintain the distance shown in the following figure:



Battery manipulation

General guidelines for battery manipulation:

- Do not expose to fire.
- Do not let the battery get wet.
- Do not open or modify the battery case.
- Do not expose the battery to ambient temperatures above 49 ° C for over 24 hours.
- Do not store the battery in temperatures below -5 ° C over seven days.
- For long term storage (more than one month), charge the battery to at least 50%.
- Do not use TALOS's battery for other purposes.
- Do not use any devices except the supplied charger to recharge the battery.
- The weight of the battery is about 8.5 kg; be careful not to drop it.
- If any damage or leakage is observed, stop using the battery.

Ankle's transmission bar warning

Maintain a safe distance from the ankle's transmission bar when the TALOS is moving, and never use it to manipulate the TALOS.



A powder-based fire extinguisher must always be available locally and used for the TALOS in the event of it catching fire. No other types of extinguishers should be used.

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.

Working with the TALOS humanoid robot – INFRA 57	
Signature:	Date: