TBM 1: The Grand Challenge (Land +Sea + Air)

Team name:	BEBOT + TOM	Kyle + HSR	
Referee I (Land):	FRANK S.	Referee II (Land): HANS - ARTHUR M. + JUHA	R
Referee I (Sea):	YVAN P.	Referee II (Sea): KELLY C.	
Referee I (Air):	STEPHEN B.	Referee II (Air): MARGARIDA	
Date (DD/MM/YYYY	22 9 17	, Time (24:00):	
Duration:	(Max. 100 m	in) Timeout	

Achievements

Set A1: Outdoors

An aerial robot reaches the waypoints (WPs) within a radius of 5 m in	A1.1	A1.2	A1.3
autonomous navigation. Waypoints can be reached in no specific order	WP1 A	WP2 A	WP3 A
and the team can suggest additional waypoints to their flight plan		Ø	
	A1.4	A1.5	A1.6
A ground robot reaches the waypoints within a precision of 3m.		WP2 L	WP5 L
		0	
	A1.7	A1.8	A1.9
A ground robot reaches the WPs within a precision of 3 m in autonomous navigation.	WP3 L	WP4 L	WP6 L
navigation.			

Within 30 minutes of start of the run, a robot reports the correct location (within radius 5 m)	A1.10
of the missing worker outside the building	N
An aerial robot deploys the first-aid kit (within radius 2 m) from the worker outside the building.	A1.11
(3m) ?	
The aerial robot transfers the first-aid kit to the land robot outside the building.	A1.12
(It must be directly deployed on the platform or within a radius of 1 m from it)	

	P	ipe damages o	on land	1
Robots reports the damages on the land pipes.	A1.13 D1 🔽	A1.14 D2 [A1.15 D3 🗆
(Each damage can only be scored once).	Robot Domain:	Robot Dom	ain:	Robot Domain:
2	KIR	-		<u>y</u>
A robot detects the leak marker on the pipe.	MIL		4	A1.16 🗹
A robot reports the pipe that is leaking on land.	ML			A1.17 🗗
A robot recognises the number on the leaking pipe	on land.			A1.18 🗆
	Outo	loor damages	(build	ling)
The robots recognise the damages on the wall of	A1.19 D1 🗆	A1.20 D2		A1.21 D3 🗆
the building.	Robot Domain:	Robot Dom		Robot Domain:
(Each damage can only be scored once).				
	<u> </u>			
A robot localises the unobstructed entrance in rea	l-time in automatic v	vay.		A1.22 🗆
	A1.23 E1	_/	A 1 2	4 E2 □
Robots localise the obstructed entrances .	Robot Dom			
	Robot Dom	nain:	Kobo	t Domain:
Robots find a safe and unobstructed path to the u	nblocked entry of the	building for a		
ground robot. (The path is shown on the map).		-		A1.25 □
From the starting point, a ground robot follows a sa	afe path (collision fre	e from obstacle	es and	
structures) to the unobstructed building entrance.				A1.26 □
The aerial robot builds a 2D or 3D map of the des	A1.27 🔽			
The aerial robot builds the map on board during th	ne flight. The map mu	ist be shown to	the	
referees just after the flight finishes.				A1.28 🗆
Robots build an outdoor map of the land pipes area	A1.29 🗆			
Robots build an outdoor map of the land pipes area	A1.30 🗆			
Robots build an outdoor map of the land pipes area	with OPIs (South-W	est side).		A1.31 🗆
Robots build an outdoor map of the land pipes area	with OPIs (South-E	ast side).		A1.32 🗆

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Set A2: Indoors

A ground robot enters the building through the unobstructed door. Within 30 minutes of start of the run, a ground robot reports the correct location of the missing worker inside the building. The missing worker is detected in real-time in an automatic way. A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the building. A ground robot(s) recognise the damages on the wall of the building. (Each damage can only be scored once). From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room. A ground robot enters the machine room ap of the building. (Use the best map or a combination of ground robots maps). A ground robot recognises the ID of the correct set of valves in the machine room. A ground robot closes the correct valve. The robot must close one valve of the set autonomously and the other one manually. The process must be recorded by the on board camera of the robot. (Note: Each set of valves has two types: gate and lever) A greefly type valve: Specify type valve: "2.1 A 2.2 A 2.3 A 2.2 A 2.3 A 2.1 A 2.4 A 2.5 D 1 A 2.6 D 2 A 2.6 D 2 A 2.7 A 2.7 A 2.8 A 2.8 A 2.9 A 2.9 Correct Valve Walve manual autonomous B 2.12 A 2.13 A 2.14 Specify type valve: "2.12						
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A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the bfillding. Indoor damages	The missing worker is detected in real-time in an automatic way.		-			A2.3
The ground robot(s) recognise the damages on the wall of the building. From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room. Aground robot recognises the machine room sign in real-time and in automatic way. Aground robot enters the machine room. Aground robot enters the machine room apof the building. Area 1	,					
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(Note: Each set of valves has two types: gate and lever) Specify type Specify type	· · · · · · · · · · · · · · · · · · ·	,				
Specify type Specify type			1.27			
	()	Specify	type	Spe	cify 1	type
				1 -	-	

Set A3: Underwater

			Туре	of image:	S		
The underwater robot provides images of the gate.	Acoustic buoy-1 ☐ A3.1 Optical buoy-1 ☐ A3.3					□ A3.3	
The under vises respectively and great		" /				al buoy-2 🏻 A3.4	
The underwater robot passes through the gate without touching it. A3.5							
The underwater robot passes through the gate within the run.	ne first	30 minut	es from th	e start of		Α.	3.6 🖸
			1.4				
		Buoys				120	
The underwater robot detects the plume buoys in real t	ime.	B1□	B2□	В3□	B4[]	B5□
Images are needed.		A3.7	A3,8	A3,9	A3.	10	A3.11
		Buoys n	umbers				
The underwater robot recognises the number on the pl	ume	В1□	В2□	В3□	B4E] [В5□
buoys		A3.12	A3.13	A3.14	A3.	15	A3.16
The underwater robot produces a geometric map of the	e plum	e (Area: F		5).			.17 🖸
The underwater robot detects the leak marker on the p	ipe in	real time,				A3	.19 🗖
The underwater robot recognises and provides images the leaking pipe.	of the	black nur	nber stam	ped on		A3.	20 🗆
The underwater robot reports which is the number of t position.	he lea	king pipe	by its geo	metric		A3	.21 🗆
			1	Pipes ur	ıderv	vater	/
The underwater robot inspects the four pipes underwaringes.	ter. Pi	rovide	10 A3.22	A3.23	3[/	4D A3.25
Following the leaking pipe up to the assembly structure image mosaic of the <u>first half</u> of the leaking pipe.	, the u	nderwate	r robot pi	rovides an		А	3.26 □
Following the leaking pipe up to the assembly structure image mosaic of the second half of the leaking pipe		nderwate	r robot pi	rovides an		А	3.27 □

	1	Pipe structu	* N	L DO
The underwater robot provides images of the structure sides.	North	South	East	West
	A3.28	A3.29	A3.30	A3.31

2	Structure Side			
The underwater robot provides a 3D reconstruction of the structure.	Front	Rear 🗆		
(20)	A3.32	A3.33		

The underwater robot localises the missing worker underwater within a radius of 5 meters.	A3.34 🔽
The underwater robot gives the dimensions and geometrical shape of the closest object to the worker.	A3.35 🗖
The underwater robot provides 3D reconstruction of the worker.	A3.36 □

The underwater robot provides a 2D acoustic or optical map of the debris.	Area 1	Area 2	
	A3.37	A3.38	

The underwater robot provides a 3D reconstruction of the manipulation console where the correct underwater valve is.	A3,39 □
The underwater robot closes the correct valve with a rotation of the <u>first 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3.40 □
The underwater robot closes the correct valve with a rotation of the <u>last 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3.41 □

Set A4: Cooperation

The underwater robot communicates the correct underwater leaking pipe to the aerial or ground robot. Directly or through the surface robot.	A4.1 □
The aerial or ground robot receives and decodes the message with the correct leaking pipe sent	
by directly by the underwater or through the surface robot.	A4.2 □
The aerial or ground robot communicates the correct land leaking pipe to the underwater robot (directly or through the surface robot).	A4.3 □
The underwater robot receives and decodes the message with the correct land leaking pipe sent by the aerial or ground robot (directly or through the surface robot).	A4.4 □
The ground robot and the underwater robot close the correct valves in a synchronised process.	A4.5 □
The aerial robot communicates to the ground robot the safe path to the building.	A4.6 □

Set A5: General

The ground robots return to the landing area once all the tasks have been done.	A5.1 🕡
The underwater robot surfaces in a controlled way once all the tasks have been done.	A5.2 🔽
The aerial robots return to the landing area once all the tasks have been done.	A5,3 🔽
The ground robot(s) transmits live position and images/video to the control station during the run.	A5.4 🗹
The aerial robot(s) transmits live position and images/video to the control station during the run.	A5.5 🔼
The marine robot(s) transmits live position and images/video to the control station during the run or the manipulation task.	A5.6

Penalised Behaviours

The robot needs manual interve	ntion during a run (e.g. the robot is stuck):	
Marine robot	No permitted	
Aerial robot	PB1 □ (max. 1)	
Ground robot 1	PB2 ☑ (max. 2)	
Ground robot 2	PB3 □ □ (max. 2)	
The ground robot leaves the	operating area,	PB4 □ (max. 1)
The ground robot changes batte	ries or is refuelled.	PB5 □ (max. 1)
The ground robot-1 hits the obs	tacles.	РВ6 □ □ □ □
The ground robot-2 hits the obs	tacles.	PB7 🗆 🗆 🗆
The underwater robot changes l	patteries,	PB8 □ (max. 1)
	at any point (GPS fix can be obtained) and re- eparation of the manipulation task is not	PB9 🔽 (max. 2)
The aerial robot does not keep wall.	he safety distance of 5 m with the building	PB10 □ □ (max. 2)

Disqualifying Behaviours

A robot damages competition arena (including the obstacles).	DB1 □
A robot does not conform to safety requirements for the competition.	DB2 □
A robot impacts the sensitive dune area.	DB3 □
A robot enters any of the upper floors of the building.	DB4 □
The aerial robot leaves the flight volumes defined by the organisation.	DB5□
The aerial robot impacts the building.	DB6 □
The aerial robot enters the building.	DB7 □
A marine robot is tele-operated (except for safety reasons agreed by the Technical Committee and the manipulation task).	DB8 □
The underwater robot closes the wrong valve underwater.	DB9 □
The ground robots close more than one wrong valve on land.	DB10 □
Comment: WARNING: A disqualifying behaviour discards all other achievements in the current task. Use it only when really necessary (e.g. cheating).	n it is
Benchmarking data delivered appropriately: yes / no (Time is 60 min after the end of the team's time-slot, formats as described in the TBM) Team leader signature:	
Accorded Signatures	

TBM 1: The Grand Challenge (Land +Sea + Air)

Team name:	RAPTORS + OUBO	T	
Referee I (Land):	FRANK S.	, Referee II (Land): SERND + /	HICHAEL
Referee I (Sea):	GINNY/VA)I	, Referee II (Sea):	NOREA
Referee I (Air):	STJEPAN B.	Referee II (Air): MARGARID	4 F.
Date (DD/MM/YY	YY): 23/09/201	(} , Time (24:00):9	2:00
Duration:	(Max. 100 m	nin) Timeout	

Achievements

Set A1: Outdoors

An aerial robot reaches the waypoints (WPs) within a radius of 5 m in autonomous navigation. Waypoints can be reached in no specific order and the team can suggest additional waypoints to their flight plan	A1.1 WP1 A	A1.2 WP2 A	A1.3 WP3 A
A ground robot reaches the waypoints within a precision of 3m.	A1.4 WP1 L	A1.5 WP2 L	A1.6 WP5 L
A ground robot reaches the WPs within a precision of 3 m in autonomous navigation.	A1.7 WP3 L	A1.8 WP4 L	A1.9 WP6 L □

Within 30 minutes of start of the run, a robot reports the correct location (within radius 5 m) of the missing worker outside the building.	A1.10
An aerial robot deploys the first-aid kit (within radius 2 m) from the worker outside the building.	A1.11
The aerial robot transfers the first-aid kit to the land robot outside the building. (It must be directly deployed on the platform or within a radius of 1 m from it)	A1.12

	Pi	ipe damages o	n land	1
Robots reports the damages on the land pipes.	A1,13 D1 🗹	A1.14 D2	Y	A1.15 D3 🗹
(Each damage can only be scored once).	Robot Domain:	Robot Doma	ain:	Robot Domain:
A robot detects the leak marker on the pipe.				A1.16 👿
A robot reports the pipe that is leaking on land.			4	A1.17 🗹
A robot recognises the number on the leaking pipe	on land.			A1.18
	Outd	oor damages	(build	ling)
The robots recognise the damages on the wall of	A1,19 D1 🗹	A1.20 D2	V	A1.21 D3 🗆
the building.	Robot Domain:	Robot Dom	ain:	Robot Domain;
(Each damage can only be scored once).	LAND + CALL	LAMP+0	nix	,
Robots localise the obstructed entrances .	A1.23 E1 Robot Dom		l'i	t Domain: Lkw C
Robots find a safe and unobstructed path to the ground robot. (The path is shown on the map).	unblocked entry of the	building for a		A1.25
From the starting point, a ground robot follows a safe path (collision free from obstacles and structures) to the unobstructed building entrance.		A1.26 🗹		
The aerial robot builds a 2D or 3D map of the designated vertical wall. NOT MP FILE		A1.27 □		
The aerial robot builds the map on board during the flight. The map must be shown to the referees just after the flight finishes.		A1.28 □		
Robots build an outdoor map of the land pipes are	a with OPIs (North-W	est side).		A1.29 🗹
Robots build an outdoor map of the land pipes are				A1.30 🔽
Robots build an outdoor map of the land pipes are				A1.31 🗹
Robots build an outdoor map of the land pipes are	ea with OPIs (South-Ea	ast side).		A1.32 📈

Set A2: Indoors

A ground robot enters the building through the unobstructed door.	A2.1/
Within 30 minutes of start of the run, a ground robot reports the correct location of the missing	A2.2
worker inside the building.	
The missing worker is detected in real-time in an automatic way.	A2.3
4	
A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the building.	A2.4/

	Indoor damages	
The ground robot(s) recognise the damages on the wall of the building. (Each damage can only be scored once).	A2.5 D1 🗹	A2.6 D2 🗹

From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room.	A2.7
A ground robot recognises the machine room sign in real-time and in automatic way.	A2.8 🗆
A ground robot enters the machine room.	A2.9 🗖

	Indoor map	
The ground robot(s) builds a geometric indoor map of the building.	Area 1	Area 2 🗹
(Use the best map or a combination of ground robots maps).	A2.10	A2.11

A ground robot recognises the ID of the correct set of valves in the machine room.	A2.12 🖬

	Correct Valve		
A ground robot closes the correct valve. The robot must close one valve of the set autonomously and the other one manually. The process must be recorded by the on board camera of the robot. (Note: Each set of valves has two types: gate and lever)	Valve manual A2.13	Valve autonomous □ A2.14	
(croto, Back of carrier and cyprose governor)	Specify type valve:	Specify type valve:	

Set A3: Underwater

*	Type of images						
The underwater robot provides images of the gate.	Acoustic buoy-1 □ A3.1 Optical buoy-1 □ A3				□ A3.3		
2				cal b	uoy-2	□ A3.4	
-	The underwater robot passes through the gate without touching it. A3.5						
The underwater robot passes through the gate within the the run.	first	30 minut	es from th	e start of		Α.	3.6 □
		Buoys					
The underwater robot detects the plume buoys in real tin	me.	В1□	B2□	В3□	B4]	B5□
Images are needed.		A3.7	A3.8	A3.9	A3.	.10	A3.11
		Buoys n	umbers				
The underwater robot recognises the number on the plus	me	B1□	B2□	В3□	B4		B5□
buoys		A3.12	A3.13	A3.14	A3	.15	A3.16
The underwater robot produces a geometric map of the plume (Area: B1+B2). A3.17 □ The underwater robot produces a geometric map of the plume (Area: B3+B4+B5). A3.18 □ The underwater robot detects the leak marker on the pipe in real time. A3.19 □ The underwater robot recognises and provides images of the black number stamped on the leaking pipe. A3.20 □ The underwater robot reports which is the number of the leaking pipe by its geometric position. A3.21 □						18 🗆 19 🗆 20 🗆	
	Pipes underwater						
The underwater robot inspects the four pipes underwater	The underwater robot inspects the four pipes underwater. Provide $1 \square 2 \square 3 \square 4 \square$					4□	
images.			A3.22	A3.23	A	3.24	A3.25
	1		u uolle 14 :	مارنده			
Following the leaking pipe up to the assembly structure, the underwater robot provides an image mosaic of the <u>first half</u> of the leaking pipe.			1	A3,26 □			
Following the leaking pipe up to the assembly structure, to image mosaic of the second half of the leaking pipe.		nderwate	r robot pi	ovides ar	า	А	3.27 🗆

		Pipe structu	re side	es
The underwater robot provides images of the structure sides.	North□	South□	East	□ West□
	A3.28	A3,29	A3.30	A3.31
/	4.5			
2		Stru	icture !	Side
The underwater robot provides a 3D reconstruction of the struc	ture.	Front	Re	ear 🗆
		A3.32	A3	3.33
The underwater robot localises the missing worker underwater	within a radi	us of 5 meters	*:	A3.34 □
The underwater robot gives the dimensions and geometrical shape of the closest object to the worker.				A3.35 □
The underwater robot provides 3D reconstruction of the worker	9			A3.36 □
The underwater robot provides a 2D acoustic or optical map of	the debris.	Area 1□		Area 2□
A3.37			A3,38	
			- 6-	7
The underwater robot provides a 3D reconstruction of the manicorrect underwater valve is.	pulation con	sole where the		A3.39 □
The underwater robot closes the correct valve with a rotation of		degrees.		
The process must be recorded by the on board camera of the robo	ot.			A3.40 □
The underwater robot closes the correct valve with a rotation of	f the <u>last 45 c</u>	legrees.		
The process must be recorded by the on board camera of the robo	ot.			A3.41 □

Set A4: Cooperation

The underwater robot communicates the correct underwater leaking pipe to the aerial or ground robot. Directly or through the surface robot.	A4.1 🗆 🕻
The aerial or ground robot receives and decodes the message with the correct leaking pipe sent by directly by the underwater or through the surface robot.	A4.2 🗆
The aerial or ground robot communicates the correct land leaking pipe to the underwater robot (directly or through the surface robot). $air \rightarrow land$ $land \rightarrow Sea$.	A4.3 🗹
The underwater robot receives and decodes the message with the correct land leaking pipe sent by the aerial or ground robot (directly or through the surface robot).	A4.4 □
The ground robot and the underwater robot close the correct valves in a synchronised process.	A4.5 □
The aerial robot communicates to the ground robot the safe path to the building.	A4.6 □

Set A5: General

The ground robots return to the landing area once all the tasks have been done.	A5.1
The underwater robot surfaces in a controlled way once all the tasks have been done.	A5.2 □
The aerial robots return to the landing area once all the tasks have been done.	A5.3 🔽
The ground robot(s) transmits live position and images/video to the control station during the run.	A5.4 🗹
The aerial robot(s) transmits live position and images/video to the control station during the run.	A5.5 🔽
The marine robot(s) transmits live position and images/video to the control station during the run or the manipulation task.	A5.6 🔽

Penalised Behaviours

The robot needs manual interver	ntion during a run (e.g. the robot is stuck):	
Marine robot	No permitted	
Aerial robot	PB □ (max. 1)	
Ground robot 1	PB2 □ □ (max. 2)	
Ground robot 2	PB3 □ □ (max. 2)	
The ground robot leaves the c	pperating area.	PB4 □ (max. 1)
The ground robot changes batter	ries or is refuelled.	PB5 □ (max. 1)
The ground robot-1 hits the obst	racles.	PB6 □ □ □ □
The ground robot-2 hits the obst	racles.	PB7 □ □ □ □
The underwater robot changes b	atteries.	PB8 □ (max. 1)
	t any point (GPS fix can be obtained) and re- paration of the manipulation task is not	PB9 □ □ (max. 2)
The aerial robot does not keep the wall.	he safety distance of 5 m with the building	PB10 □ □ (max. 2)

Disqualifying Behaviours

A robot damages competition arena (including the obstacles).	DB1 □
A robot does not conform to safety requirements for the competition.	DB2 □
A robot impacts the sensitive dune area.	DB3 □
A robot enters any of the upper floors of the building.	DB4 □
The aerial robot leaves the flight volumes defined by the organisation.	DB5□
The aerial robot impacts the building.	DB6 □
The aerial robot enters the building.	DB7 □
A marine robot is tele-operated (except for safety reasons agreed by the	
Technical Committee and the manipulation task).	DB8 🗆
The underwater robot closes the wrong valve underwater.	DB9 □
The ground robots close more than one wrong valve on land.	DB10 □
Comment:	it is
Benchmarking data delivered appropriately:	
(Time is 60 min after the end of the team's time-slot, formats as described in the TBM)	
Team leader signature: Idual Ren Holang	lue

TBM 1: The Grand Challenge (Land +Sea + Air)

Team name:	ROBDOS + IHM	+ IIS PIOMBINO
Referee I (Land):	FRANK S.	, Referee II (Land): BERND + MICHAEL
Referee I (Sea):	KELLY	, Referee II (Sea): HITESH
Referee I (Air):	STJEPAN B	Referee II (Air): MARGARIDA F.
Date (DD/MM/Y)	YYY): 23/09/201	7 Time (24:00):
Duration:	(Max. 100	min) Timeout

Achievements

Set A1: Outdoors

An aerial robot reaches the waypoints (WPs) within a radius of 5 m in	A1.1	A1.2	A1.3
autonomous navigation. Waypoints can be reached in no specific order	WP1 A	WP2 A	WP3 A
and the team can suggest additional waypoints to their flight plan		D/	
	A1.4	A1.5	A1.6
A ground robot reaches the waypoints within a precision of 3m.	WP1 L	WP2 L	WP5 L
	D	12	DY.
	A1.7	A1.8	A1.9
A ground robot reaches the WPs within a precision of 3 m in autonomous navigation.	WP3 L	WP4 L	WP6 L
navigation.	₩.	四	P

Within 30 minutes of start of the run, a robot reports the correct location (within radius 5 m)	A1.10
of the missing worker outside the building.	4
An aerial robot deploys the first-aid kit (within radius 2 m) from the worker outside the building.	Al.H
The aerial robot transfers the first-aid kit to the land robot outside the building.	A1.12
(It must be directly deployed on the platform or within a radius of 1 m from it)	Q.

	Pipe damages on land			
Robots reports the damages on the land pipes,	A1.13 D1 🗹	A1.14 D2	V	A1.15 D3 🗹
(Each damage can only be scored once).	Robot Domain:	Robot Dom	ain:	Robot Domain
	LAND tail	a air		air
A robot detects the leak marker on the pipe.				A1.16
A robot reports the pipe that is leaking on land,			/d	A1.17
				A1.17 ur
A robot recognises the number on the leaking pipe	on land.			A1.18 🗖
	Out	door damages	s (build	ding)
The robots recognise the damages on the wall of	A1.19 D1 🗹	A1.20 D2	Ø	A1.21 D3 🗹
the building.	Robot Domain: Robot Domain:		ain:	Robot Domain
(Each damage can only be scored once).	Ltwo tail _Ltwo ta		tail	_ LAND +
A robot localises the unobstructed entrance in rea	l-time in automatic	way.		A1.22
Robots localise the obstructed entrances.	A1.23 E	1 150	1 1 2	4 E2 🗹
Robots localise the obstructed entrances.		nain: LANG	' - · · -	t Domain:
Robots find a safe and unobstructed path to the u ground robot. (The path is shown on the map).	nblocked entry of th	e building for a		A1.25 🔯
From the starting point, a ground robot follows a sa structures) to the unobstructed building entrance.	fe path (collision fre	ee from obstacle	es and	A1.26
The aerial robot builds a 2D or 3D map of the desi	gnated vertical wall			A1.27 🔽

The aerial robot builds the map on board during the flight. The map must be shown to the

Robots build an outdoor map of the land pipes area with OPIs (North-West side).

Robots build an outdoor map of the land pipes area with OPIs (North-East side).

Robots build an outdoor map of the land pipes area with OPIs (South-West side).

Robots build an outdoor map of the land pipes area with OPIs (South-East side).

A1.28 🗆

A1.29

A1,30 🗹

A1.31

A1.32

referees just after the flight finishes.

Set A2: Indoors

A ground robot enters the building through the unobstructed door.	A2.1
Within 30 minutes of start of the run, a ground robot reports the correct location of the missing worker inside the building.	A2.2
The missing worker is detected in real-time in an automatic way.	A2.3
A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the building.	A2.4

	Indoor damages	
The ground robot(s) recognise the damages on the wall of the building. (Each damage can only be scored once).	A2.5 D1 🔽	A2.6 D2 🖸

From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room.	A2.7 ☑
A ground robot recognises the machine room sign in real-time and in automatic way.	A2.8 🗹
A ground robot enters the machine room.	A2.9 🗹

	Indoor map		
The ground robot(s) builds a geometric indoor map of the building.	Area l 🗹	Area 2 🗹	
(Use the best map or a combination of ground robots maps).	A2.10	A2.11	

	,
A ground robot recognises the ID of the correct set of valves in the machine room.	A2.12 🗹

	Correct Valve	
A ground robot closes the correct valve. The robot must close one	Valve	Valve
valve of the set autonomously and the other one manually. The	manual	autonomous
process must be recorded by the on board camera of the robot.	□ A2.13	□ A2.14
(Note: Each set of valves has two types: gate and lever)		
	Specify type valve:	Specify type
	valve:	valve:

Set A3: Underwater

*							
	Type of images						
The underwater robot provides images of the gate.	Acoustic buoy-1 A3.1 Optical			otical buoy-1 A3,3		□ A3,3	
2	Acc	Acoustic buoy-2 □ A3,2 Option			ical b	cal buoy-2 □ A3.	
TILL I A LA L	h a 114 4	ovahina i	4				
The underwater robot passes through the gate with				\$		Α.	3.5 🗆
The underwater robot passes through the gate within the run.	he firs	t 30 minut	es from th	e start of		Α.	3.6 🗆
		Buoys					
The underwater robot detects the plume buoys in real	time.	В1□	В2□	В3□	В4		В5□
Images are needed.		A3.7	A3.8	A3.9	A3	.10	A3.11
		Buoys n	umbers				
The underwater robot recognises the number on the pl	ume	В1□	В2□	В3□	B4□		В5□
buoys		A3.12	A3.13	A3.14	A3	,15	A3.16
				ii.			
The underwater robot produces a geometric map of the	e plum	ie (Area: F	B1+B2).		T	4.2	17 🗆
				-\	4	A3.	1/ 🔲
The underwater robot produces a geometric map of the			33+B4+B3)#i		A3.	18 🗆
The underwater robot detects the leak marker on the p	ipe in	real time.				A3.	19 🗆
The underwater robot recognises and provides images	of the	black nur	nber stam	ped on	ř		20.
the leaking pipe.						А3.	20 🗆
The underwater robot reports which is the number of t	he lea	king pipe	by its geor	netric		4.2	21 🗆
position.						A3	21 🗆
		_		D.I.			
				Pipes u			
The underwater robot inspects the four pipes underwa	ter. Pi	rovide	10	2 🗆			4□
images.			A3.22	A3.23	A	.3.24	A3.25
	41			1		1	
Following the leaking pipe up to the assembly structure, the underwater robot provides an image mosaic of the <u>first half</u> of the leaking pipe.			A	3.26 □			
Following the leaking pipe up to the assembly structure image mosaic of the second half of the leaking pipe		nderwate	r robot pr	ovides ar)	A	3.27 □
2.						1	

	Pipe structure sides			
The underwater robot provides images of the structure sides.	North□	South□	East□	West□
	A3 28	A3,29	A3.30	A3.31

if the second se	Structure Side		
The underwater robot provides a 3D reconstruction of the structure.	Front	Rear 🗆	
	A3.32	A3.33	

The underwater robot localises the missing worker underwater within a radius of 5 meters.	A3.34 □
The underwater robot gives the dimensions and geometrical shape of the closest object to the worker.	A3.35 🗆
The underwater robot provides 3D reconstruction of the worker.	A3,36 □

The underwater robot provides a 2D acoustic or optical map of the debris.	Area 1□	Area 2□
	A3.37	A3.38

The underwater robot provides a 3D reconstruction of the manipulation console where the correct underwater valve is.	A3.39 □
The underwater robot closes the correct valve with a rotation of the <u>first 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3.40 □
The underwater robot closes the correct valve with a rotation of the <u>last 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3.41 □

Set A4: Cooperation

The underwater robot communicates the correct underwater leaking pipe to the aerial or	
ground robot. Directly or through the surface robot.	A4.1 □
The state of the s	-
The aerial or ground robot receives and decodes the message with the correct leaking pipe sent	
by directly by the underwater or through the surface robot.	A4.2 🗖
The aerial or ground robot communicates the correct land leaking pipe to the underwater robot	/
(directly or through the surface robot).	A4.3
directly of through the surface roots.	
The underwater robot receives and decodes the message with the correct land leaking pipe sent	
	A4.4 🗆
by the aerial or ground robot (directly or through the surface robot),	A4,4 L
The ground robot and the underwater robot close the correct valves in a synchronised process.	A4.5 □
	A4.3 L
The aerial robot communicates to the ground robot the safe path to the building.	
The actial tobot communicates to the ground robot the safe path to the ounding.	A4.6 □

Set A5: General

The ground robots return to the landing area once all the tasks have been done.	A5.1 🔯
The underwater robot surfaces in a controlled way once all the tasks have been done.	A5.2 □
The aerial robots return to the landing area once all the tasks have been done.	A5.3 🗹
The ground robot(s) transmits live position and images/video to the control station during the run.	A5.4 🗖
The aerial robot(s) transmits live position and images/video to the control station during the run.	A5.5 🕡
The marine robot(s) transmits live position and images/video to the control station during the run or the manipulation task.	A5.6 □

Penalised Behaviours

The robot needs manual interve	ntion during a run (e.g. the robot is stuck):	
Marine robot	No permitted	
Aerial robot	PB1 □ (max. 1)	
Ground robot 1	PB2 □ □ (max. 2)	
Ground robot 2	PB3 □ □ (max. 2)	
The ground robot leaves the	operating area.	PB4 □ (max. 1)
The ground robot changes batte	ries or is refuelled.	PB5 □ (max. 1)
The ground robot-1 hits the obs	tacles.	PB6 🗆 🗆 🗆
The ground robot-2 hits the obs	tacles.	PB7 🗆 🗆 🗆
The underwater robot changes b	patteries.	PB8 □ (max. 1)
	at any point (GPS fix can be obtained) and re- eparation of the manipulation task is not	PB9 □ □ (max. 2)
The aerial robot does not keep t wall.	he safety distance of 5 m with the building	PB10 □ □ (max. 2)
The underwater robot changes to the underwater robot surfaces a submerges. (The surface for prepenalised) The aerial robot does not keep to the surface for prepenalised.	oatteries. at any point (GPS fix can be obtained) and re- eparation of the manipulation task is not	PB8 □ (max. 1) PB9 □ □ (max. 2)

Disqualifying Behaviours

A robot damages competition arena (including the obstacles).	DB1 🗖
A robot does not conform to safety requirements for the competition.	DB2 □
A robot impacts the sensitive dune area.	DB3 □
A robot enters any of the upper floors of the building.	DB4 □
The aerial robot leaves the flight volumes defined by the organisation.	DB5□
The aerial robot impacts the building.	DB6 □
The aerial robot enters the building.	DB7 □
A marine robot is tele-operated (except for safety reasons agreed by the Technical Committee and the manipulation task).	DB8 🗆
The underwater robot closes the wrong valve underwater.	DB9 □
The ground robots close more than one wrong valve on land.	DB10 □
WARNING: A disqualifying behaviour discards all other achievements in the current task. Use it only when really necessary (e.g. cheating).	it is
Benchmarking data delivered appropriately: ✓ yes / □ no (Time is 60 min after the end of the team's time-slot, formats as described in the TBM)	
Team leader signature:	

TBM 1: The Grand Challenge (Land +Sea + Air)

Team name:	TELERO	B + U.	GIRONA +	ISEF	P/INESC	TEC	
Referee I (Land):	HANS AR	THUX M+	Mich C. Referee II	(Land):_	BERND	1+	JUHA L
Referee I (Sea):	VLAOT	Q.	, Referee I	I (Sea):	to or	LEA	
Referee I (Air):	STJEP	AN B.	, Referee I	I (Air):	MARGAR	IDA	F.
Date (DD/MM/Y	YYY):	22/09/2	2017	, Time	e (24:00):	14:	05
Duration:		(Max.	100 min) Time	out			

Achievements

Set A1: Outdoors

An aerial robot reaches the waypoints (WPs) within a radius of 5 m in autonomous navigation. Waypoints can be reached in no specific order and the team can suggest additional waypoints to their flight plan		A1.2 WP2 A	A1.3 WP3 A
		×	X
	A1.4	A1.5	A1.6
A ground robot reaches the waypoints within a precision of 3m.	WP1 L	WP2 L	WP5 L
			Ø
	A1.7	A1.8	A1.9
A ground robot reaches the WPs within a precision of 3 m in autonomous navigation.	WP3 L	WP4 L	WP6 L
navigation. Yes, but not			

Within 30 minutes of start of the run, a robot reports the correct location (within radius 5 m)	A1.10
of the missing worker outside the building.	X
An aerial robot deploys the first-aid kit (within radius 2 m) from the worker outside the building.	A1.11
WAY FAR	
The aerial robot transfers the first-aid kit to the land robot outside the building.	A1.12
(It must be directly deployed on the platform or within a radius of 1 m from it)	

		Pi	pe damages o	n lan	d ,
Robots reports the damages on the land pipes.	A1.13 D1	D	A1.14 D2		A1.15 D3 D
(Each damage can only be scored once).	Robot Dor	nain:	Robot Dom	ain:	Robot Domain:
, a	LAND		LAND	(2)	(ML) (3)
A robot detects the leak marker on the pipe.	7				Al-16 🗷
A robot reports the pipe that is leaking on land.	- C	1 4 Va	and		A1.17 🗵
A robot recognises the number on the leaking pipe	on land.				A1.18 🔼
		Outdo	oor damages	(buile	ding)
The robots recognise the damages on the wall of	A1.19 D	1	A1.20 D2	1	A1.21 D3 🗹
the building.	Robot Doi	-	Robot Dom		Robot Domain:
(Each damage can only be scored once).	Ltv) t		LMD+		MR
A robot localises the unobstructed entrance in rea	al-time in auto	matic wa	ay.		A1.22 🗆
		Not			
Robots localise the obstructed entrances.	A1.	23 E1 [1	A1.2	.4 E2 □
	Rob	ot Doma	in: Ltv 0	Robo	ot Domain Mr O
Robots find a safe and unobstructed path to the u	inblocked enti	y of the	building for a		
ground robot. (The path is shown on the map).			-		A1.25 🗷
From the starting point, a ground robot follows a sa	afe path (colli	sion free	from obstacle	s and	A126 10
structures) to the unobstructed building entrance.					A1.26 🗹
The aerial robot builds a 2D or 3D map of the des	signated vertic	al wall.	? Mu	pe	A1.27
The aerial robot builds the map on board during the					
	he flight. The	map mus	st be shown to	the	A128 M
referees just after the flight finishes.	he flight. The	map mus	st be shown to	the	A1.28
				the	A1.28 🗹
referees just after the flight finishes.	a with OPIs (1	lorth-We	est side).	the	
referees just after the flight finishes. Robots build an outdoor map of the land pipes area	a with OPIs (N	North-We	est side).	the	A1.29 🗷

Set A2: Indoors

A ground robot enters the building through the unobstructed door.	A2.1
Within 30 minutes of start of the run, a ground robot reports the correct location of the missing worker inside the building.	A2.2
The missing worker is detected in real-time in an automatic way.	A2.3
A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the building.	A2.4

	Indoor d	amages
The ground robot(s) recognise the damages on the wall of the building. (Each damage can only be scored once).	A2.5 D1 🗹	A2.6 D2 🗹

From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room.	A2.7 🕡
A ground robot recognises the machine room sign in real-time and in automatic way.	A2.8 □
A ground robot enters the machine room.	A2.9

	Indoor map	
The ground robot(s) builds a geometric indoor map of the building.	Area 1 🗹	Area 2 🔽
(Use the best map or a combination of ground robots maps).	A2.10	A2.11

A ground robot recognises the ID of the correct set of valves in the machine room.	A2.12 🗖

	Cort	rect Valve
A ground robot closes the correct valve. The robot must close one valve of the set autonomously and the other one manually. The process must be recorded by the on board camera of the robot. (Note: Each set of valves has two types: gate and lever)	Valve mapual M A2.13	Valve autopomous
	Specify type valve: bar	Specify type valve: wheel

Set A3: Underwater

Set 113. Chack water							
•	Type of images						
The underwater robot provides images of the gate.	Acoustic buoy-1 A3.1 Optica			cal b	al buoy-1 A3.3		
3	Acc	ustic buoy	y-2 ☑ A3.	2 Opti	cal b	al buoy-2 □ A3.4	
The underwater robot passes through the gate wit	hout t	ouching i	t.	4		A.	3.5
The underwater robot passes through the gate within t the run.	he firs	t 30 minut	es from th	e start of		A.	3.6
					•		
		Buoys	/	/ /		/	1
The underwater robot detects the plume buoys in real lmages are needed.	time.	B1□ A3.7	B2 D / A3.8	B3.7 A3.9	B4[A3.	ates:	B5 🔼
		Buoys n		i, t	c =		
The underwater robot recognises the number on the pl	lume	B1□	B2□	В3□	B4[B5□
buoys		A3.12	A3.13	A3.14	A3.	15	A3.16
The underwater robot produces a geometric map of th	e plum	ie (Area: F	31+B2).			A3.17 🗳	
The underwater robot produces a geometric map of th	e plum	ne (Area: I	33+B4+B5	5).		A3.	.18 🗹
The underwater robot detects the leak marker on the p	ipe in	real time.				A3.	.19 🗆
The underwater robot recognises and provides images the leaking pipe.	of the	black nur	nber stam	ped on		A3.	.20 🗆
The underwater robot reports which is the number of the leaking pipe by its geometric position.					A3.	,21 🗆	
Pipes underwater				,			
The underwater robot inspects the four pipes underwa	iter. P	rovide	117	2/2	30	1	40
images.			A3.22	A3.23	1.0	3.24 7	A3.25
	.1		1 4				
Following the leaking pipe up to the assembly structure, the underwater robot provides an image mosaic of the <u>first half</u> of the leaking pipe.				A	3.26 🗆		
Following the leaking pipe up to the assembly structure image mosaic of the second half of the leaking pipe		nderwate	r robot pr	ovides an	1	A	3.27 🗆

	Pipe structure sides			/
The underwater robot provides images of the structure sides.	North	South	East	West
	A3.28	A3.29	A3.30	A3:31

*	Struct	Structure Side			
The underwater robot provides a 3D reconstruction of the structure.	Front	Rear 🗆			
	A3.32	A3.33			

The underwater robot localises the missing worker underwater within a radius of 5 meters.	A3.34 □
The underwater robot gives the dimensions and geometrical shape of the closest object to the worker.	A3,35 □
The underwater robot provides 3D reconstruction of the worker,	A3.36 □

The underwater robot provides a 2D acoustic or optical map of the debris.	Area 1□	Area 2□
	A3.37	A3.38

The underwater robot provides a 3D reconstruction of the manipulation console where the	A3.39 □
correct underwater valve is.	
The underwater robot closes the correct valve with a rotation of the first 45 degrees.	
The process must be recorded by the on board camera of the robot.	A3.40 □
The underwater robot closes the correct valve with a rotation of the last 45 degrees.	
The process must be recorded by the on board camera of the robot.	A3.41 □

Set A4: Cooperation

The underwater robot communicates the correct underwater leaking pipe to the aerial or ground robot. Directly or through the surface robot.	A4.1 🗆
The aerial or ground robot receives and decodes the message with the correct leaking pipe sent by directly by the underwater or through the surface robot.	A4.2 🗷
The aerial or ground robot communicates the correct land leaking pipe to the underwater robot (directly or through the surface robot).	A4.3 🗷
The underwater robot receives and decodes the message with the correct land leaking pipe sent by the aerial or ground robot (directly or through the surface robot).	A4.4 🗹
The ground robot and the underwater robot close the correct valves in a synchronised process.	A4.5 🗆
The aerial robot communicates to the ground robot the safe path to the building.	A4.6 🗷

Set A5: General

The ground robots return to the landing area once all the tasks have been done.	A5.1 🗹
The underwater robot surfaces in a controlled way once all the tasks have been done.	A5.2 🗗
The aerial robots return to the landing area once all the tasks have been done.	A5.3 🗷
The ground robot(s) transmits live position and images/video to the control station during the run.	A5.4 🗹
The aerial robot(s) transmits live position and images/video to the control station during the run.	A5.5 🔀
The marine robot(s) transmits live position and images/video to the control station during the run or the manipulation task.	A5.6 🗹

Penalised Behaviours

The robot needs manual intervention during a run (e.g. the robot is stuck):					
Marine robot	No permitted				
Aerial robot	PB1 □ (max. 1)				
Ground robot 1	PB2 □ □ (max. 2)				
Ground robot 2	PB3 □ □ (max. 2)				
The ground robot leaves the o	operating area.	PB4 □ (max. 1)			
The ground robot changes batter	PB5 □ (max. 1)				
The ground robot-1 hits the obst	PB6 □ □ □ □				
The ground robot-2 hits the obst	PB7 □ □ □ □				
The underwater robot changes b	PB8 □ (max. 1)				
The underwater robot surfaces a	рро 🗖 🗇 (2)				
submerges. (The surface for preparation of the manipulation task is not penalised) PB9 (max. 2)					
The aerial robot does not keep the wall.	PB10 🗆 🗀 (max. 2)				

Disqualifying Behaviours

A robot damages competition arena (including the obstacles).	DB1 □
A robot does not conform to safety requirements for the competition.	DB2 □
A robot impacts the sensitive dune area.	DB3 □
A robot enters any of the upper floors of the building.	DB4 □
The aerial robot leaves the flight volumes defined by the organisation.	
	DB5□
The aerial robot impacts the building.	DB6 □
The aerial robot enters the building.	DB7 □
A marine robot is tele-operated (except for safety reasons agreed by the	DB8 🗆
Technical Committee and the manipulation task).	
The underwater robot closes the wrong valve underwater.	DB9 □
The ground robots close more than one wrong valve on land.	DB10 E
Comment:	_
WARNING: A disqualifying behaviour discards all other achievements in the current task. Use it only when really necessary (e.g. cheating).	n it is
Benchmarking data delivered appropriately: ✓ yes / □ no	
(Time is 60 min after the end of the team's time-slot, formats as described in the TBM)	
Team leader signature:	na
Al Degree	
Referee signature:	

TBM 1: The Grand Challenge (Land +Sea + Air)

Team name:	TUSCANY	7,7			
Referee I (Land):	FRANK S.	_, Referee II (Land):	Beh	J. K.	
	GINMK	, Referee II (Sea):	RAY	, 2	
	STEPHANZ.	, Referee II (Air):	MAR	GALIDA	$F_{\mathbb{P}_{1}}$
Date (DD/MM/YY	YY): 22 9 17	, Time	(24:00):	09:30)
Duration:	(Max. 100 m	in) 🗆 Timeout			

Achievements

Set A1: Outdoors

An aerial robot reaches the waypoints (WPs) within a radius of 5 m in autonomous navigation. Waypoints can be reached in no specific order and the team can suggest additional waypoints to their flight plan	A1.1	A1.2	A1.3
	WP1 A	WP2 A	WP3 A
A ground robot reaches the waypoints within a precision of 3m.	A1.4	A1.5	A1.6
	WP1 L	WP2 L	WP5 L
A ground robot reaches the WPs within a precision of 3 m in autonomous navigation.	A1.7	A1.8	A1.9
	WP3 L	WP4 L	WP6 L

Within 30 minutes of start of the run, a robot reports the correct location (within radius 5 m) of the missing worker outside the building.	A1.10
An aerial robot deploys the first-aid kit (within radius 2 m) from the worker outside the building.	A1.11
The aerial robot transfers the first-aid kit to the land robot outside the building.	A1.12
(It must be directly deployed on the platform or within a radius of 1 m from it)	

	- I	ipe damages of	iland	
Robots reports the damages on the land pipes.	A1.13 D1 🔽	A1.14 D2.	A1.15 D3 🗔	
(Each damage can only be scored once).	Robot Domain:	Robot Domai	in; Robot Domai	
	ALC	AR	AR	
.!				
A robot detects the leak marker on the pipe.			A1.16	
A robot reports the pipe that is leaking on land.			A1.17	
A robot recognises the number on the leaking pipe	on land.		A1.18	
	Outo	loor damages (building)	
The robots recognise the damages on the wall of	A1.19 D1 🔽	A1.20 D2 🗆	A1.21 D3 E	
the building.	Robot Domain:	Robot Domai	in: Robot Domai	
(Each damage can only be scored once).	AIR			
		- 1		
A robot localises the unobstructed entrance in rea	al-time in automatic v	vay.	A1.22	
	4.1.22 E1	/	A1.24 E2 🗹	
Robots localise the obstructed entrances . A1.23 E1 A1.24 Robot Domain: Robot				
D. L. C. J. C. J. W. L. Awards J. Brath to the	unblooked onto of the	huilding for a		
Robots find a safe and unobstructed path to the unblocked entry of the building for a ground robot. (The path is shown on the map).				
From the starting point, a ground robot follows a safe path (collision free from obstacles and structures) to the unobstructed building entrance.				
The aerial robot builds a 2D or 3D map of the designated vertical wall.				
The aerial robot builds the map on board during the flight. The map must be shown to the referees just after the flight finishes.				
Robots build an outdoor map of the land pipes area with OPIs (North-West side).				
Robots build an outdoor map of the land pipes area with OPIs (North-East side).				
Robots build an outdoor map of the land pipes area with OPIs (South-West side).				
Robots build an outdoor map of the land pipes area	with OPIs (South-Ea	ast side).	A1.32 [

Set A2: Indoors

A ground robot enters the building through the unobstructed door	A2.1
Within 30 minutes of start of the run, a ground robot reports the correct location of the missing worker inside the building.	A2.2 □
The missing worker is detected in real-time in an automatic way.	A2.3 □
A ground robot deploys the first-aid kit (within radius 1 m) from the worker inside the building.	A2.4

	Indoor damages		
The ground robot(s) recognise the damages on the wall of the building. (Each damage can only be scored once).	A2.5 D1 🖬	A2.6 D2 🔽	

From the building entrance, a ground robot follows a safe path (collision free from obstacles and structures) to the machine room.	A2.7 🗖
A ground robot recognises the machine room sign in real-time and in automatic way.	A2.8 🗆
A ground robot enters the machine room.	A2.9 📭

	Indoor map		
The ground robot(s) builds a geometric indoor map of the building.	Area 1 🗆	Area 2 🗆	
(Use the best map or a combination of ground robots maps).	A2.10	A2.11	

A ground robot recognises the ID of the correct set of valves in the machine room. A2.12	2 🗆
---	-----

	Correct Valve	
A ground robot closes the correct valve. The robot must close one valve of the set autonomously and the other one manually. The process must be recorded by the on board camera of the robot.	Valve manual A2.13	Valve autonomous ☐ A2.14
(Note: Each set of valves has two types: gate and lever)	Specify type valve:	Specify type valve:

Set A3: Underwater

*	Type of images						
The underwater robot provides images of the gate.	Acoustic buoy-1 TA3.1 Optical				cal bu	al buoy-1 A3.3	
Acoustic buoy-2 A3.2 Optical					cal bu	юу-2	□ A3.4
The underwater robot passes through the gate with				.6		A3	.5 🖫
The underwater robot passes through the gate within the run.	ne first	30 minute	es from th	e start of		A3	6.6
		Buoys		,			/
The underwater robot detects the plume buoys in real t	ime.	B1□	B2	В3□	B4D] [B5[7
Images are needed.		A3.7	A3.8	A3.9	A3.	10	A3.11
		Buoys n	umbers				
The underwater robot recognises the number on the pla	ume	B1□	В2□	В3□	B4C] [B5□
buoys				A3,:14	A3.	15	A3.16
The underwater robot produces a geometric map of the plume (Area: B1+B2). A3.17 The underwater robot produces a geometric map of the plume (Area: B3+B4+B5). A3.18 The underwater robot detects the leak marker on the pipe in real time. A3.19 The underwater robot recognises and provides images of the black number stamped on the leaking pipe. A3.20 The underwater robot reports which is the number of the leaking pipe by its geometric position. A3.21					18 🗆 19 🗆 20 🗆		
				Pines III	nderv	vater	
The underwater robot inspects the four pipes underwater. Provide 1 2 3						4□	
images.	tor _e r	ovide	A3.22	A3.23		- 3.24	A3.25
Following the leaking pipe up to the assembly structure, the underwater robot provides an image mosaic of the <u>first half</u> of the leaking pipe.				ì	A	3.26 □	
Following the leaking pipe up to the assembly structure, the underwater robot provides an image mosaic of the <u>second half</u> of the leaking pipe.			А	3.27 🗖			

	Pipe structure sides			
The underwater robot provides images of the structure sides,	North□	South□	East□	West□
	A3,28	A3.29	A3.30	A3_31
	NO.			

3e	Structure Side		
The underwater robot provides a 3D reconstruction of the structure.	Front	Rear 🗆	
	A3.32	A3.33	

The underwater robot localises the missing worker underwater within a radius of 5 meters.	A3.34 □
The underwater robot gives the dimensions and geometrical shape of the closest object to the worker.	A3.35 □
The underwater robot provides 3D reconstruction of the worker.	A3.36 □

The underwater robot provides a 2D acoustic or optical map of the debris.	Area 1□	Area 2□
	A3.37	A3.38

The underwater robot provides a 3D reconstruction of the manipulation console where the correct underwater valve is.	A3.39 □
The underwater robot closes the correct valve with a rotation of the <u>first 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3.40 □
The underwater robot closes the correct valve with a rotation of the <u>last 45 degrees</u> . The process must be recorded by the on board camera of the robot.	A3,41 □

Set A4: Cooperation

The underwater robot communicates the correct underwater leaking pipe to the aerial or ground robot. Directly or through the surface robot.	A4.1 🗆
The aerial or ground robot receives and decodes the message with the correct leaking pipe sent by directly by the underwater or through the surface robot.	A4.2 □
The aerial or ground robot communicates the correct land leaking pipe to the underwater robot (directly or through the surface robot).	A4.3 🗆
The underwater robot receives and decodes the message with the correct land leaking pipe sent by the aerial or ground robot (directly or through the surface robot).	A4.4 □
The ground robot and the underwater robot close the correct valves in a synchronised process.	A4.5 □
The aerial robot communicates to the ground robot the safe path to the building.	A4.6 □

Set A5: General

The ground robots return to the landing area once all the tasks have been done.	A5.1 □
The underwater robot surfaces in a controlled way once all the tasks have been done.	A5.2
The aerial robots return to the landing area once all the tasks have been done.	A5,3 □
The ground robot(s) transmits live position and images/video to the control station during the run.	A5.4
The aerial robot(s) transmits live position and images/video to the control station during the run.	A5.5 🔽
The marine robot(s) transmits live position and images/video to the control station during the run or the manipulation task.	A5.60

Penalised Behaviours

The robot needs manual intervention during a run (e.g. the robot is stuck):			
Marine robot	No permitted		
Aerial robot	PB1 (max. 1)		
Ground robot 1	PB2 🗹 🗹 (max. 2)		
Ground robot 2	PB3 □ (max. 2)		
The ground robot leaves the operating area.		PB4 □ (max. 1)	
The ground robot changes batteries or is refuelled.		PB5 □ (max. 1)	
The ground robot-1 hits the obstacles.		PB6 □ □ □ □	
The ground robot-2 hits the obstacles.		PB7 🗆 🗆 🗆	
The underwater robot changes batteries.		PB8 □ (max. I)	
The underwater robot surfaces at any point (GPS fix can be obtained) and resubmerges. (The surface for preparation of the manipulation task is not penalised)		PB9 □ □ (max. 2)	
The aerial robot does not keep the safety distance of 5 m with the building wall.		PB10 □ □ (max. 2)	

Disqualifying Behaviours

A robot damages competition arena (including the obstacles).	DB1 🗆
A robot does not conform to safety requirements for the competition.	DB2 C
A robot impacts the sensitive dune area.	DB3 □
A robot enters any of the upper floors of the building.	DB4 🗆
The aerial robot leaves the flight volumes defined by the organisation.	DB5□
The aerial robot impacts the building.	DB6 □
The aerial robot enters the building.	DB7 □
A marine robot is tele-operated (except for safety reasons agreed by the Technical Committee and the manipulation task).	DB8 □
The underwater robot closes the wrong valve underwater.	DB9 □
The ground robots close more than one wrong valve on land.	DB10 [
WARNING: A disqualifying behaviour discards all other achievements in the current task. Use it only when really necessary (e.g. cheating). Benchmarking data delivered appropriately: yes / no	it is
benchmarking data delivered appropriately: pryes / \(\sigma \text{no} \)	
(Time is 60 min after the end of the team's time-slot, formats as described in the TBM)	
Team leader signature:	
Referee signature:	