Thrust Area Working Group # 6 – Space and Rockets

Steering Group Report

TAWG #6 – Space and Rockets

MANITOBA AEROSPACE

Team Composition

- Chair, Diane Kotelko, Magellan Aerospace
- Deputy Chair, Wendell Wiebe, MAHRC
- Igor Telichev, University of Manitoba
- Howard Loewen, Micropilot
- David Bertin, Red River College
- Sylvie Beland, NRC

Current State

Exploration

Space Mining

Space Manufacturing

Earth Observation

Communications

Barriers

Reliability

Communication Bandwidth

Orbital Debris

Radiation

Launch Cost

Weight, Size

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Goals

Space Mining

Earth Observation

Communications

Exploration

Space Manufacturing

Current State

Amazon Delivery

Transportation

Search and Rescue – Hostile Environments

Tactical Surveillance

Test and Eval. Targets

Barriers

Reliability

Communication Bandwidth

Other aircraft

Topography

Cost

Weight, Size

Safety!

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Goals

Delivery

Transportation

SAR - Hostile

Tactical Surveillance

Test and Eval. Targets

Two sides to Autonomy:

Google

Directions to Hilton Winnipeg Airport Suites
1800 Wellington Ave, Winnipeg, MB R3H 1B2
9.1 km – about **14 mins**

A 12 Byron Bay, Winnipeg, MB R3K 0R7

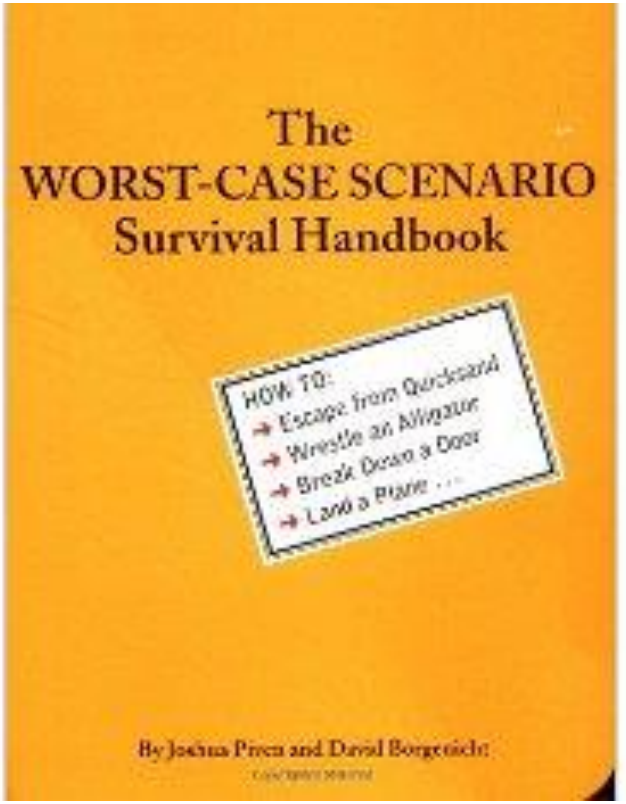
1.	Head **west** on **Byron Bay** toward **Kirkfield St**	go 100 m total 100 m
2.	Turn right onto **Kirkfield St**	go 230 m total 350 m
3.	Take the 1st right onto **Mcbey Ave**	go 120 m total 450 m
4.	Take the 1st left onto **Banting Dr**	go 290 m total 750 m
5.	Take the 1st right onto **Portage Ave/Rte 85 W** About 7 mins	go 5.1 km total 5.9 km
6.	Turn left onto **Ferry Rd** About 3 mins	go 1.8 km total 7.7 km
7.	Turn right onto **Ellice Ave** About 48 secs	go 550 m total 8.2 km
8.	Take the 1st left onto **Berry St** About 1 min	go 800 m total 9.0 km
9.	Turn right onto **Wellington Ave** Destination will be on the left	go 76 m total 9.1 km

B **Hilton Winnipeg Airport Suites**
1800 Wellington Ave, Winnipeg, MB R3H 1B2

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map data ©2014 Google

Directions weren't right? Please find your route on maps.google.ca and click "Report a problem" at the bottom left.



Enabling Technologies - Autonomy

		Satellites & Rockets	UAVs
Planned Mission - Reduced operator costs - Reduced on-board costs - Reduced processor load	Target Selection	Unpredicted opportunities - Solar storms - “Garbage” collection - Conflicting priorities	- Search / surveillance missions
	Assessment of Current State	- Changing validity/accuracy of sensors - Alternative sensors	- Changing validity/ accuracy of sensors - Alternative Sensors
	Prediction of Future State	- Position, attitude, propellant load	- Position, attitude, fuel,

Enabling Technologies – Autonomy (cont'd)

		Satellites & Rockets	UAVs
Unplanned Events - Minimized outages = maximum value - Mission success - Mission safety	Failure Detection - on-board sensors - environment	- Component failure - - On-orbit debris (BEFORE impact)	- Component failure - Unexpected obstacles (BEFORE impact)
	Failure Isolation – Minimize risk to mission	– no opportunity to repair	– safety!
	Failure Recovery	- Reconfigure to continue - Defensive manoeuvres	- Reconfigure to continue - Defensive manoeuvres

Critical Enabling Technology – Autonomy

Description

- Perform nominal mission with less operator interaction
  - On-board algorithms to combine lower cost sensors to provide equivalent accuracy to higher cost sensors
  - On-board algorithms to maximize output of systems where independent subsystems are competing for limited resources
- Respond to off-nominal conditions with less operator interaction
  - Adaptive control systems to recognize changes to the sensors, actuators, environment and physical plant under control.
  - Failure detection, isolation and recovery algorithms that are adaptive.

Critical Enabling Technology – Autonomy

Timeline for Technologies

- *Ongoing for UAV, agile marketplace.*
- *Next major Canadian spacecraft mission has already started early phase development.*

Concept and Cost to Implement

- "Autonomy Innovation Centre" – a series of cross-company, cross-industry (including academia), collaborative R&D projects aimed at increasing TRL levels from 3 to 6 or higher.
- Simulators of varying fidelity up to, and including, UAV flights and spacecraft hardware-in-the-loop.
- Up to $10M – over 5 years with

Critical Enabling Technology – Autonomy

Manitoba's Role

• Collaboration/partners including: U of M, Micropilot, Magellan

Risks if not implemented in Manitoba

• Challenging competitive environment;

- Satellites have limited market
- UAV autopilots have more competition

• Risk of losing relevance when always focussed on final implementations