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Wolfgang Fink

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Introduction

Space exploration technologies face several extreme environments, not only in interplanetary and orbital missions but also during in situ missions targeting planetary atmospheres, surfaces, and sub-surfaces. Terrestrial parallels exist in potentially hazardous or inaccessible operational areas on Earth such as those related to military (battlefield, check points, mine-fields), terrorist activities (stand-off detection of IEDs), or areas that have been exposed to bio-chemical agents, radiation, or natural disasters. Advanced technologies are required that go beyond conventional manned and robotic planetary exploration missions, which are inadequate to address the needs for the next generation of missions that will be necessary to pave the way for human exploration back to the Moon and to Mars, and also for autonomous deployment in battlefield scenarios.

In the particular case of reconnaissance missions, some of the key features to be afforded by future mission architectures include:

- Global to regional to local reconnaissance; mission safety and redundancy (i.e. fault-tolerance)
- (real time) Identification and characterization of transient events
- Targeted agent/sensor deployment in regions of interest (e.g., “hot” zones)
- Optimized target identification and obstacle avoidance
- Efficient commanding of multiple ground agents.

Potential applications range from planetary exploration and mining, to homeland security, border control, battlefield surveillance, harbor surveillance, maritime vessel tracking, telecommunications relay, and weather observations.

As with all space missions, payload mass, size, power consumption, and communication remain the overarching constraints/challenges. Moreover, to support and control future space exploration mission architectures, a high degree of operational autonomy is necessary. Essential requirements of such operation autonomy are:

- Automatic mapping of an operational area from different vantage points (i.e., space, airborne, surface/subsurface), including vehicle health monitoring
- Automatic feature extraction and target/region-of-interest/anomaly identification within the mapped operational area, which includes sensor data fusion, sensor interoperability, and intelligent data downlink
- Automatic target prioritization for close-up examination and timely counter-measures
- Automatic (targeted) deployment and (concurrent) navigation of sensor platforms and individual sensors.

The scope of the conference includes topics in basic research in hardware and software development, component and subsystem level development, and design and implementation of missions for space, defense, and homeland security applications.

Wolfgang Fink