Infusion of Vision Systems into Planetary Landers[*]

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During the Apollo Moon landings, astronauts sighted landmarks for precision landing and looked out the window during final descent to avoid craters and boulder fields in order to land safely. Since then, new vision technologies have advanced to a level where these capabilities are now present in terrestrial robotic systems like self-driving cars and military drones. There is a strong desire to place these capabilities on planetary landers to enable access to the most scientifically compelling locations that may also happen to be quite hazardous for landing.

Multiple challenges must be overcome before a new technology for planetary landing can be accepted onto a space mission. In addition to the usual constraints in size, weight and power, such technologies must withstand the very harsh launch and landing temperatures, vibration, shock and radiation. In addition the technology must work perfectly the first time it is applied, which requires internal checking of results and fault protection. Even after all these challenges are met, a space mission will only use a new technology if it is absolutely necessary.

In this talk, I will review two case studies in technology infusion. The first is the Lander Vision System, which estimates position and will be used on the Mars 2020 mission to enable access to challenging sites that appear to be the best for collecting samples with possible evidence of past life on Mars. This technology success story was the product of years of technology development and testing, and a relentless promotional effort by proponents from the science and technology communities. The second case is the Hazard Detection System, which automatically identifies safe landing locations during descent. This technology had a similar development path as the Lander Vision System, but unfortunately will not fly in its current instantiation. I will touch on the reasons for this but also describe a new effort to bring a similar capability to a potential Europa Lander, a mission concept that is attempting to avoid development pitfalls while satisfying the needs of a very challenging application domain.

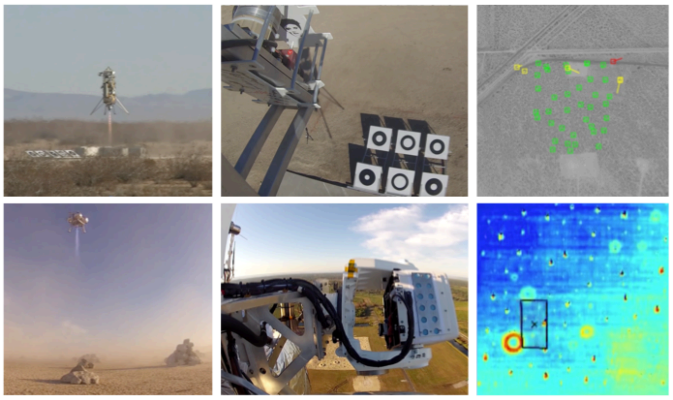

Figure 1 Both the Lander Vision System (top) and the Hazard Detection System (bottom) were successfully demonstrated on vertical take off and landing rockets.

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