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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Martian dust devils detector over FPGA" *by* E. de Lucas et al.

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The authors gratefully acknowledge Walter Schmidt for their detailed and highly constructive criticisms, which greatly helped us to improve the quality and presentation of our manuscript. In the following, we provide detailed, item-by-item, point-by-point responses to all the very interesting issues raised by him.

1. The reviewer indicates that "A complication for space applications at least in the near future could be the radiation sensitiveness of the reprogramming features in the used components which seem to have the tendency to fail at a much lower total radiation dose than the performance specification of the programmed operational circuits otherwise indicates". We agree with this opinion and think that the companies that design FPGAs should try to fix this numbers. Moreover, the research community should develop strategies to minimize the impact of this low level of resistance to radiation.

We have added a brief paragraph in the paper to show this problem: "Although FPGAs are very promising to be used in space applications, they have several problems that must be fixed in the future in order to be a really practical solution. The main problem seems to be that the radiation sensitiveness of this technology is higher than stated by the manufacturer. So, more research must be done in this issue in order to get FPGAs totally reliable."

2. The reviewer says "In the introduction section the authors should at least mention the additional complexity for component firmware verification related to the quality assurance requirements for space instrumentation." We have added a paragraph in the introduction section that states this problem: "In space applications always exists an additional cost, of the designed circuits, dedicated to verify the quality requirements of the instrumentation."

3. The reviewer indicates "Also the instrumental overhead for reliably store the downloadable code of the firmware modules to be exchanged should be evaluated, as the reliability requirements for the related storage medium will be higher than for standard processor-based software". We do not totally agree with the reviewer; in our opinion the reliability requirements of the storage medium will be similar for the bitstream of an FPGA than for the code of a program.

4. The reviewer indicates "It would be informative to include an estimate for the typical time needed to perform a partial reprogramming.". In section 2.4 we have shown this cost, adding the following sentence: "In a Virtex II the time used to reconfigure one fifth of the total reconfigurable area is around 4 ms."

5. The reviewer indicates "Reports of large dust devils on Earth and Mars are mentioned but no reference is given". In page 4 there is a reference to Renno et al. that mention this phenomenon.

6. The reviewer indicates that the instrument on Mars Pathfinder must be mentioned. We have added this mention.

7. We have replaced the quote “NASA” with “NASA Planetary Data System” and we have updated the quoted link to the correct one: http://pds-atmospheres.nmsu.edu/cgi-bin/getdir.pl?dir=index&volume=mpam_0001.

8. The reviewer says that data sampling intervals could be too large. Really these intervals have been used because they are able to detect the same dust devils that were detected in the actual mission, but the features of the FPGA allow using intervals sensibly smaller.

9. The reviewer asked “The rational for using the configuration values as listed in table 1 should be explained. Are they auto-adapted via the LTA calculations or statically based on tests with the observational data?” We have introduced the following comment in section 2.4.6: “The number of samples of each set could be changed dynamically depending on the evolution of the algorithm, using larger sets when it is necessary more sensitivity.”

10. The reviewer indicates that “While the usage of integer arithmetic is certainly justified for such a hardware implementation, the authors should evaluate the effect of the introduced errors. The effects to be detected in the data represent only a small fraction of the dynamic range of the data sets, so that rounding effects caused by integer operations could have the same order of magnitude as the data variation caused by a passing dust devil.“. We have introduced a note in section 2.4.1 that show that we are working with fixed point numbers because with these data is possible but in other situations will be necessary to use floating point numbers.

Please also note the supplement to this comment:
http://www.geosci-instrum-method-data-syst-discuss.net/1/C72/2012/gid-1-C72-2012-supplement.pdf

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Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 1, 1, 2011.