# CMLA Wins 2016 IARPA Multi-View Stereo 3D Mapping Challenge

*Carlo de Franchis, Gabriele Facciolo and Enric Meinhardt-Llopis of the image processing group at CMLA, ENS Paris-Saclay, win the IARPA sponsored challenge on 3D reconstruction from satellite images.*

Images produced by earth observation satellites have been used to solve problems ranging from geographic mapping to weather forecast, and include applications as diverse as measuring glacier evolution, agricultural monitoring, or rescue assistance for natural disasters. New companies like Planet and Terra Bella are boosting earth observation by launching dozens of high resolution satellites. Users will be offered next year a daily or even a hourly earth coverage, which opens the way to uncountable economic and societal applications. Yet, for this to happen, a huge amount of data must be analysed automatically, and algorithms are lacking.

In this context IARPA (Intelligence Advanced Research Projects Activity) sponsored a challenge for extracting altimetry data from an arbitrary collection of high-resolution satellite images. The challenge was organized by Topcoder, the leading website in the competitive programming community. The challenge was divided in two contests—Explorer and Master—the second contest raising the difficulty level. Both contests attracted nearly 700 registrants. They sported one of the largest prizes ever proposed by Topcoder with a prize purse of 100.000 USD.

Dealing with dozens of non simultaneous satellite images for 3D reconstruction is a new and challenging problem. Only 24 of the 700 registrants managed to submit a solution on time, and only 10 got a score above the minimum threshold required to be ranked!

The CMLA image processing group ranked second in the Explorer Challenge and won the Master Challenge. CMLA's multi-image and multi-dates solution expanded on S2P, an image processing pipeline initially developed at CMLA for extracting 3D information from stereo pairs and triplets of the French earth observation satellite Pleiades[1].
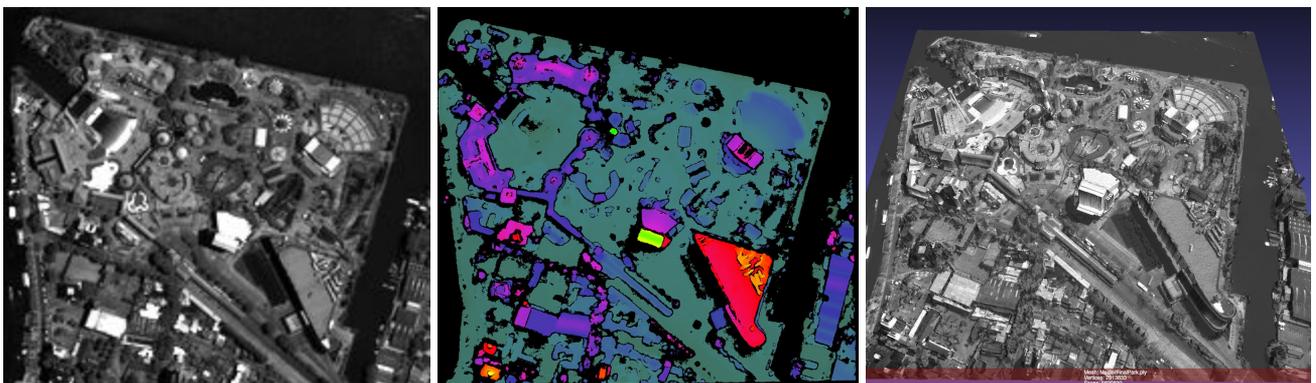


Fig.1 Left: extract of an input image; Middle: computed elevation map; Right: computed 3D mesh. The dataset for the challenge consisted of 50 Worldview-3 images at 30 cm resolution taken on Buenos Aires over 14 months. Most of the images were taken at different dates with a wide range of viewing directions.

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[1] Pleiades was the first earth observation satellites explicitly conceived for 3D cartography. It was developed by CNES (French space agency) ; CMLA participated to its design.

Fig. 2: Final classification published on IARPA website. CMLA submission username is *carlito*.



Fig. 3: Final classification and scores on topcoder website. CMLA submission username is *carlito*.