Airbus Automatic derived Ground Control Points

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Abstract

Reliable Ground Control Points (GCPs), i.e., points of known geographical coordinates, are an essential input for the precise orthorectification of remote sensing imagery, the exact location of targets or the accurate georeferencing of a variety of geo-datasets. Although GCPs collected by terrestrial means typically offer a high accuracy, with the Airbus Radar Constellation GCPs can be collected from Space as well. The space borne approach allows Airbus to collect GCPs all over the world and in areas where access can be hazardous or may not be authorised. Thanks to the precise orbit determination accuracy (within the range of centimetres) of the Airbus Radar Constellation, the precise radar beam tracing, its high spatial resolution and the resulting high positional accuracy of the imagery, the satellite proves to be highly suitable for obtaining 3D ground information. Based on stereo imagery or multiple image datasets acquired at defined geometrical conditions, GCPs can be obtained at a high accuracy in East (E), North (N) coordinates and in Height (H). The subsequent use of the retrieved points is to establish a global control point database, particularly in poorly mapped areas, where such information is not available or insufficiently accurate.

The Airbus Radar Constellation Satellites TerraSAR-X, TanDEM-X and Paz are capable of high-resolution and multi-beam image acquisition. Along with the image data, detailed and very precise orbit data allow for highly accurate 3D information extraction based on stereo or multi-angle image data sets. The image geolocation positioning error is proved to be less than 10 cm in azimuth and range.

For automated radargrammetric ground control point extraction, a minimum of two images acquired with the same orbit direction or, ideally, from ascending and descending orbits are acquired over the area of interest. The Range and Doppler equations are utilized to extract the underlying epipolar geometry and to rectify both images such that the stereo parallaxes are limited to one dimension. To avoid manual point of interest selection, point shaped objects are extracted by applying a matched filter yielding potential coordinates of such metal poles with pixel accuracy. To get the subpixel center of the objects a local patch is upsampled using FFT and an energy functional is optimized over the gradient magnitude of border pixels. The center of the optimal segment is then determined as the center of mass using the upsampled amplitude values. To minimize the potential error by the atmosphere, local weather data are used to account for path delay variation of the travelling time of the incident and backscattered radar signal.

Keywords - Processing algorithms