Application of an advanced algorithm for automated hyperbola detection, including Canny edge detector, to GPR data from IFSTTAR test field

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Automated processing and extraction of useful information from GPR data is a complicated task, for which various approaches have been developed during the last years. This work examines the introduction of Canny edge detector as a new preliminary step of an advanced algorithm for automated hyperbola detection [1, 2]. The overall algorithm aims to identify radargram portions wherein hyperbolic reflections apices are present and extract the coordinates of such apices.

The newly introduced step utilizing Canny edge detector consists of two main procedures: (1) identification of edge pixels in a radargram and (2) elimination of edge pixels that do not meet specific criteria. The latter procedure aims to accelerate the algorithm by reducing the number of pixels, without compromising the correct detection and localization of hyperbola apices. For the elimination of unnecessary edge pixels, different criteria have been designed and tested; a practical solution has been found, which yields the elimination of the highest number of unnecessary edge pixels without eliminating useful edge pixels. No pixels are eliminated from the close vicinity of hyperbola apices since it is better to keep a higher number of edge pixels than to eliminate useful ones. In the implementation of the algorithm, special attention has been paid to its execution time, thinking of real-time applications.

The upgraded algorithm was tested on experimental radargrams from IFSTTAR (The French Institute of Science and Technology for Transport, Development, and Networks) test field in Nantes, France [3]. That test field consists of vertical sections filled with different materials and hosting many buried objects, such as cables and pipes, or walls and stones, imitating common scenarios in urban areas. Radargram acquisition was done using antennas with different central frequencies. Radargrams containing hyperbolic reflections were selected and used for testing the upgraded algorithm, with promising results.

References

