# Hardware implementation of non-uniformity correction algorithms for high-resolution microbolometer arrays

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## Abstract

The dissertation presents the author's solution to the problem of non-uniformity correction of high-resolution microbolometer arrays. The main objective of the work was the proposal of a new algorithm for non-uniformity correction. The algorithm is dedicated to be used in correction of data, acquired with utilization of uncooled microbolometer arrays.

Requirements regarding the solution included the need of performing the algorithm as part of a hardware implementation of the microbolometer array controller. Furthermore, the utilization of uncooled microbolometer array resulted in the need of adaptability of the proposed methodology. The term adaptability is defined by an ability to update the array correction parameters, in response to the temporal changes of the array's microbolometers response characteristics.

As stated in the dissertation, microbolometer response characteristic may not be linear. However, most of the literature works assume a linear model of the characteristic. The proposed algorithm refers to that problem, through utilization of non-linear partially linear model.

In the process of the design of the algorithm's hardware implementation, a two-stage non-uniformity correction processing flow was proposed. The processing stages included: stripe non-uniformity correction and non-uniformity correction algorithm, based on non-linear model. The proposal has been optimized for the use in the hardware implementation of the microbolometer array controller.

The proposed solution has been subjected to a series of experimental tests, carried out using an uncooled thermal imaging camera. The camera was capable of acquisition of XGA resolution thermal images at 30 frames per second. The camera controller was implemented in an FPGA programmable logic device. The proposed solution allowed for the compensation of negative effects, resulting from the temporal changes and non-linearities of the array's microbolometers response characteristics.

The effect of the work is an adaptive algorithm, capable of performing efficient non-uniformity correction, intended for correction of data, acquired from high-resolution, uncooled microbolometer arrays. The solution is optimized with consideration of hardware implementation. Furthermore, the algorithm refers to the non-linearities of the array's microbolometers.

**Keywords:** non-uniformity correction, NUC, hardware acceleration, FPGA, microbolometer arrays, infrared focal plane arrays, IRFPA.