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Development of a low cost uncooled infrared system dedicated to long term monitoring of transport infrastructures

Rodolphe Averty and Jean Dumoulin
Université Nantes Angers Le Mans (UNAM), IFSTTAR, Route de Bouaye, BP 4129, 44341 Bouguenais Cedex, France

One of the objectives of ISTIMES project is to evaluate the potentialities offered by the integration of different electromagnetic techniques able to perform non-invasive diagnostics for surveillance and monitoring of transport infrastructures. Among the EM methods investigated, uncooled infrared camera is a promising technique due to its dissemination potential according to its low cost on the market. Furthermore, to tackle our final aim in ISTIMES project that is to use it in a stand alone configuration on various transport infrastructures, adaptation and new development of on the shelf commercial systems are required.

Infrared thermography, when it is used in quantitative mode (not in laboratory conditions) and not in qualitative mode (vision applied to survey), requires to process in real time thermal radiative corrections on raw data acquired to take into account influences of natural environment evolution with time. But, camera sensor has to be enough smart to applied in real time calibration law and send apparent temperature maps computed to a dedicated database or storage area closed or not closed to the structure. So, data transfer has to be address but also remote control of the camera has also to be taken into account in communication protocol used.

A fast Ethernet camera FLIR A320 was selected to build a demonstrator. First developments were made with a commercial SDK proposed by the provider but limitations were rapidly found in particular in Wireless mode and also when one want to insert its own radiative measurement models. To solve that problem, development were made under Linux using OpenSource and complementary software developed by our own. Such choice required to have access to raw data inside the infrared camera. It has been made possible thanks to a specific agreement signed with FLIR company.

So a new HMI was developed with various functionalities. Among them, we want to point out the possibility offer now to work in wire or wireless communication mode depending on what can be done for implementation on real site.

Furthermore, first innovation was the possibility to use a dedicated wireless card “PEGASE” developed at IFSTTAR (not a simple wireless bridge) equipped with a DSP and GPS. For that, a specific kernel was developed and inserted in this card. It allows preliminary configuration of the infrared sensor connected to PEGASE for instance to fix the frequency of thermal images acquisition with or without averaging. Then thermal images are sent to an ftp server, or an SMTP server (mail), using WIFI or GSM communication channel.
Nevertheless, such solution does not entirely match the objective of ISTIMES project due the limitation of amount of free memory available on PEGASE and limited performances of its DSP. So, new development where made using mini-PC available on the market and their GPU computational potentialities.

The second innovation was the development of a set of mathematical function that can be used to build radiative corrections and calibration law models. Models are then compiled to produce libraries. These libraries are used with a high level API hiding internals. So, IHM briefly evocated before takes now benefit of these libraries for making apparent temperature data conversion from raw data using new models without any modification of the original software. Tests made with a mini-PC using CUDA GPU show us that we can gain 40 times and more performance ratio versus standard CPU (computing and displaying thermal images in the same time).

Different tests were made in real site, in particular at the falling block test site (in the framework of ISTIMES project) where different EM sensing techniques were used in the same time to monitor a Civil engineering structure under such mechanical solicitation.

Finally, this last development will open the possibility to test in real time processing algorithms also studied in non destructive testing by active infrared thermography for the detection of potential defective areas on transport infrastructures under weather and/or traffic solicitations.

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