

# Thermotopographic Imaging of Electron Beam Additive Manufacturing Process using Infra-Red Camera with a Dedicated Numerical Solution

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## ABSTRACT

In this work we integrated a dedicated design of a thermal imaging IR camera on an electron beam melting machine - ARCAM Q20+. Using the camera data with a simplified numerical code, the camera's thermotopographic maps were extended to get 3D temperature maps of the powder bed and built plate.

In EBAM process, the beam is passing through the powder bed at a very high speed, i.e. the time scale is very small. The thermal time scale of the process is much larger, connected to the thermal diffusivity of the material (Ti6Al4 in our work). Hence, the thermal behaviour of the powder-solid is captured using a relatively simple IR camera. Furthermore, the thermal data from the camera are used as a boundary condition of a simplified numerical model. In this model, it is *not* necessary to model the electron beam energy deposition and environmental thermal conditions of the melt surface (radiation mostly), leading to fast computation times.

During the EBAM process, there is x-ray radiation and ionized particles that are being released in the printing vacuum chamber. Therefore, the IR camera was placed outside the vacuum chamber of the EBAM machine, using a special designed periscope. Since the thermal properties of the powder-solid are highly dependent on temperature, the IR camera had to be calibrated with special calibration procedures<sup>[1], [2]</sup>.

The combination of IR camera and numerical analysis has high potential. Due to the fast computation times, the calculation can be performed in-situ, and moreover, the numerical solution data can be used to correct the EBAM parameters, thus leading to higher quality printed parts.

## REFERENCES

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