EURO*fusion*
TECHNOLOGY TRANSFER PROGRAMME

Infrared thermography diagnostics for high temperature materials control

In magnetic confinement fusion machines, plasma-facing components are subjected to high heat fluxes that can cause damages. Based on many years of research works on magnetic confinement fusion at CEA, fusion experts developed a software suite for high-performance thermal imaging diagnostics. ThermaVIP platform can directly exploit all your sensor data to improve process control and understand accelerated ageing and damage of materials under high thermal stress. Any industry or laboratory whose processes or machines involve control of materials at high temperatures could be interested in this technology : metallurgy and steel, cement, glass and plastic industries, manufacture of electronic components, power lasers, particle accelerators and any high temperature industrial installations or test benches.

Description of the technology

The ThermaVIP ("Viewing Imaging Platform") is a software platform which provides the necessary tools for the delayed and real-time exploitation of sensor data, including imaging, to facilitate the understanding of the observed process. This may involve, for example, analyzing the physical phenomena that have occurred in a tokamak to understand their impacts on the machine. ThermaVIP is based on a modular and open source architecture that allows new sensors, algorithms or graphic components to be easily integrated. Its unique graphical interface, designed for end users, offers an ergonomic solution dedicated to the visualization/handling of heterogeneous signals. Thermadiag offers software solutions to facilitate the operation of your imaging sensors during operations. ThermaVIP integrates software modules dedicated to the acquisition of infrared or visible films from sensors, their storage and archiving in a database that can be consulted later.


① THERMAVIP - OFFLINE ANALYSIS

Thermavip provides a unique and user-friendly graphical interface for visualization and analysis of multi-sensor data. It is directed toward operational supervisors, maintenance supervisors and the staff operating the machine. This version is used for offline analysis based on a sensor database.
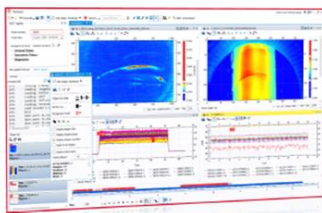
② THERMAVIP - REAL-TIME ANALYSIS

Thermavip provides software modules for acquisition, online visualization and archiving of infrared/visible camera videos, as well as other sensor data. Thermadiag uses the knowledge of your process experts to build a customized software solution dedicated to the detection of thermal anomalies and defects in materials during real time operations. This solution safely fits into your supervision system without altering it.
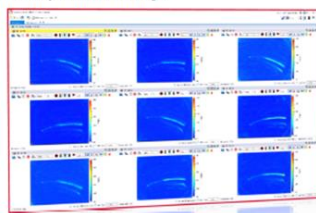
③ THERMAVIP - TOKIDA 3D

Tokida 3D is a Thermavip application aiming to visualize 3D CAD models of your device and simulate camera fields of view, create synthetical videos based on 3D thermal models, and map videos onto 3D models. It is mainly directed toward the scientific staff designing/operating the video diagnostics of your process.
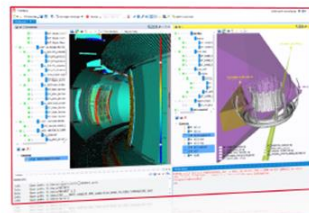
④ THERMAVIP - AERIAL SURVEILLANCE

This software helps you visualizing / synchronizing / analysing telemetry data and IR videos acquired during a drone aerial surveillance of you installation. It provides High level tools to dynamically map the aerial surveillance videos into a 3D CAD model of your installation. This software is directed toward operational and maintenance supervisors.
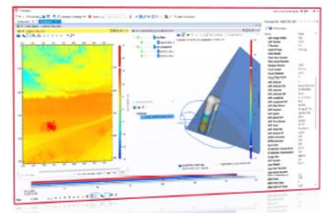
Thermavip is based on 4 layers :

- The Qt library which is the only external dependency of Thermavip. You will need a version of Qt >= 5.4
- A Software Development Kit (SDK) composed of 5 shared libraries: Logging, DataType, Plotting, Core and Gui. Those libraries only rely on QtCore, QtGui, QtWidgets, QtXml and QtNetwork.
- The plugins, dynamic libraries containing user specific functionalities based on the SDK. These plugins generally provide tools to interact with additional data format (like new video files), display additional GUI features or define new signal processing routines. A plugin can depend on a subset of the SDK or the full SDK. It can also use additional external libraries.
- The Thermavip executable itself, which is basically just a plugin container. Its main purpose it to load the plugins from within the VipPlugins directory. Thermavip defines 2 different executables: Thermavip.exe that displays a Graphical User Interface (GUI) and Thtools.exe (same as Thermavip.exe but without a GUI and GUI related libraries, for real-time systems mainly).

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Innovation and advantages of the offer

– Better control of the processes through a better understanding of what is happening at the heart of the process (as for example the overheating of a component)
– Keep control of this analysis tools: master the analysis tools with your own sensor, algorithms or graphic components
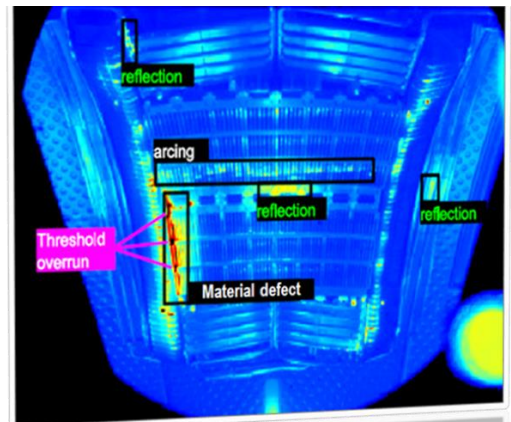– Easy integration into an existing sensor environment/monitoring system

Non-fusion Applications

Any industry or laboratory whose processes or machines involve control of materials at high temperatures could be interested in this technology : metallurgy and steel, cement, glass and plastic industries, manufacture of electronic components, power lasers, particle accelerators and any high temperature industrial installations or test benches.

This software is directed toward operational and maintenance supervisors and help them visualizing / synchronizing / analyzing telemetry data and IR videos acquired. It provides High level tools to dynamically map a 3D CAD model of your installation.

EUROfusion Heritage

In magnetic confinement fusion machines, plasma-facing components are subjected to high heat fluxes that can cause damages. These damages are reinforced by leakage currents that impose point/localized concentrations of heat and radiation. Therefore, the CEA - IRFM has developed high-performance thermal imaging diagnostics for Tore Supra's and West's Tokamaks, dedicated to protecting these components and providing a physical understanding of thermal phenomena. ThermaVIP is used daily on 3 tokamaks (WEST/FR, JET/UK, W7-X/DE) for real-time IR acquisition and offline analysis of sensor data.

Detection of thermal anomalies in the Tore Supra tokamak (CEA)

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