



HAL
open science

Study of hot box detection on moving targets using way side thermal infrared camera and image processing methods : application to railway infrastructures

Jean Dumoulin, Boualem Merainani, Thibaud Toullier

► To cite this version:

Jean Dumoulin, Boualem Merainani, Thibaud Toullier. Study of hot box detection on moving targets using way side thermal infrared camera and image processing methods : application to railway infrastructures. European Geosciences Union, Apr 2024, Vienne (Autriche), France. 10.5194/egusphere-egu24-16481 . hal-04798431

HAL Id: hal-04798431

<https://inria.hal.science/hal-04798431v1>

Submitted on 22 Nov 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

EGU24-16481

EGU General Assembly 2024

© Author(s) 2024. This work is distributed under the Creative Commons Attribution 4.0 License.



Study of hot box detection on moving targets using way side thermal infrared camera and image processing methods : application to railway infrastructures

Jean Dumoulin, Boualem Merainani, and Thibaud Toullier

Université Gustave Eiffel, Inria, COSYS-SII, I4S Team, F-44344 Bouguenais, France (jean.dumoulin@univ-eiffel.fr)

In a context of European rail traffic growing rapidly, infrastructure managers are pushed to develop reliable solutions to improve safety and operational performance. This is a challenging task given 229853 km of network (28070 km in France only) [1]. For instance, in 2018, the total maintenance and renewable expenditure exceeds €20.6 billion in Europe (€5.4 billion for France) [2] and this is continuing to rise.

In the present study we focus on the bogie component, a complex and important element in rail-road cars. Overheated rail-road car wheels and bearings known as hot boxes, are a major threat for any railway operation. Extensive research have been done, where remote and contactless condition monitoring technologies have been developed [3]. Among them, a class of system are based on thermal sensors, such as hot box detector (HBD) currently installed in the European railway. Such systems involve a high installation and maintenance cost. Furthermore, they are dependent to other facilities, like triggers to activate and deactivate the system. So, cost-less, robust and easy to maintain critical systems monitoring solutions have to be investigated.

With the advancements in both image sensor technology and processing capabilities, machine vision-based techniques may provide cost-effectiveness and easier solution for hot wheels and hot axle bearings detection.

In this research work, automatic detection, tracking and counting of hot boxes is addressed through the implementation of way side infrared thermal cameras. First a discussion on thermal cameras required performances will be proposed and new uncooled fast pixel sensors will be introduced. Implementation on a real railway will be presented and discussed. Then, some image processing methods ([4], [5]) developed and studied in this work will be presented and applied to infrared thermal images (IRTIs) taken by different wayside camera models. Finally, the advantages of remote way-side thermal cameras with deep learning techniques will be discussed and perspectives will be proposed.

Acknowledgments

SNCF Réseau and BRIGHTER project. BRIGHTER has received funding from the KDT Joint Undertaking (JU) under grant agreement No 101096985. The JU receives support from the European Union's Horizon Europe research and innovation program and France, Belgium, Portugal, Spain, Turkey.

References

- [1] EU Commission. "COMMISSION STAFF WORKING DOCUMENT, REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL. Seventh monitoring report on the development of the rail market under Article 15(4) of Directive 2012/34/EU of the European Parliament and of the Council". In: (2021).
- [2] IRG Rail. Ninth Annual Market Monitoring Report. 2021.
- [3] Amir Falamarzi, Sara Moridpour, and Majidreza Nazem. "A review on existing sensors and devices for inspecting railway infrastructure". In: *Journal Kejuruteraan* 31.1 (2019), pp. 1–10.
- [4] Thibaud Toullier, Jean Dumoulin, Vincent Bourgeois. "Comparative study of moving train hot boxes predetection and axles counting by in-situ implementation of two infrared cameras". In: *QIRT Asia 2019 Conference*. 2019.
- [5] Boualem Merainani, Thibaud Toullier, Jean Dumoulin. "Moving train wheel axles automated detection, counting, and tracking by combining AI with Kalman filter applied to thermal infrared image sequences". In: *SPIE Optical Metrology 2023. Proceedings*. Munich, Germany: SPIE, June 2023. doi: 10.1117/12.2675719.