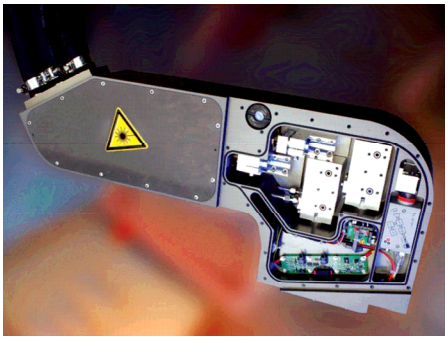
Fraunhofer Institut Lasertechnik

# Line focus optics for cleaning railroad rails with computer-controlled focus position



Optical system with focus position control and monitoring

Thin films of compacted leaves as well as lubrication grease and water on railroad rails reduce the traction between wheel and rail. This reduces the acceleration and braking capacity of rail vehicles and leads to delays as well as increased wear of wheelsets and rails. Conventional methods using abrasive particles to remove these surface residues result in increased wear of wheels and rails. Cleaning methods using brushes or high-pressure water jets achieve limited cleaning performance, are subject to tool wear and require cleaning agents. The laser-based cleaning system developed at the Fraunhofer ILT permits the non-contact and wear-free removal of rail residues at speeds of up to 60 km/h. In this system the radiation of a fiber-coupled pulsed Nd:YAG laser is converted by means of a transformation optical system into a line that maintains the original power density at a high aspect ratio.

Initial tests of the optical system successfully verified its function. It was found, however, that adjustment and adaptation to different duty conditions involved considerable effort. The use a motorized focus position setting and an integrated camera system for monitoring the focus position should appreciably simplify the installation and operation of the optical system and ensure a high cleaning speed.

## Method

Owing to its large dynamic range, a CMOS camera, which is coaxially integrated in the beam path, is used to detect the size of focus on the rail. The laser radiation scattered on the rail surface is collimated by the focusing lens group and is decoupled by a divider mirror. Using a compact lens system developed for this application, the radiation is imaged on the CMOS chip, creating an enlarged image of a section of the linear focus. To set the focus position, the focusing lens group can be shifted 20 mm using an electric motor and a spindle drive.

## Results and applications

Tests conducted at LASERTHOR Company with a cleaning vehicle successfully verified that the system works. In addition to monitoring the focus position, the integrated camera also permits online process monitoring. Further software programming would allow use of the existing components to automatically control the focus position.

**Fraunhofer-Institut für Lasertechnik ILT**

Director
Prof. Dr. rer. nat. Reinhart Poprawe M.A.
Vice Director
Prof. Dr. rer. nat. Peter Loosen

Steinbachstraße 15
D-52074 Aachen

Contact
Dipl.-Ing. H.-D. Hoffmann
Phone +49 (0) 2 41/89 06 - 206
Fax +49 (0) 2 41/89 06 - 121
dieter.hoffmann@ilt.fraunhofer.de
www.ilt.fraunhofer.de

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