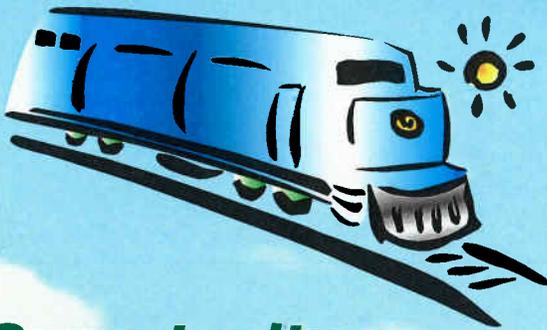


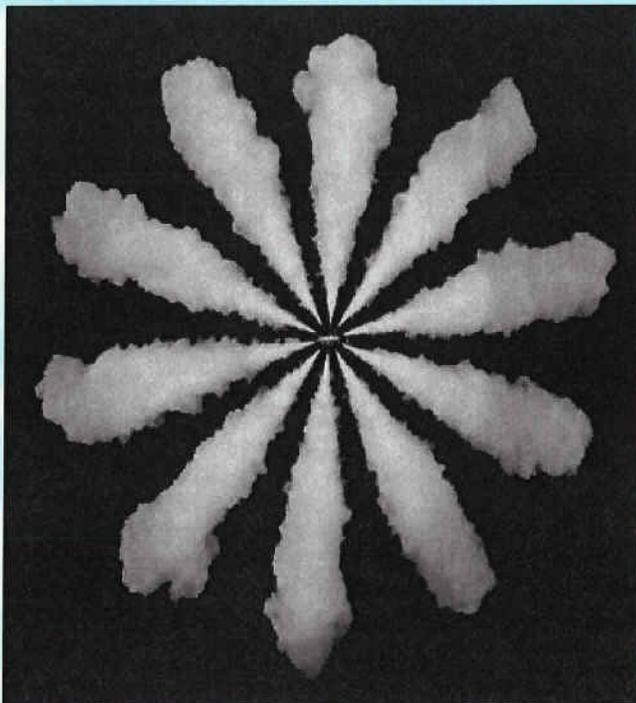
Imaging Fuel Spray from Locomotive Fuel Injectors



Opportunity

During the 1990s, the U.S. Environmental Protection Agency (EPA) introduced new rules limiting exhaust emissions from diesel locomotives. These rules apply to new locomotives and to post-1973 locomotives when they are rebuilt.

Reducing exhaust emissions improves air quality, but most emissions-reduction techniques also reduce fuel efficiency. Fuel is a railroad's major operating cost, so locomotive manufacturers must identify emissions-reduction solutions that do not also reduce fuel economy.



Argonne's Solution

Leading diesel locomotive manufacturer Electro-Motive Diesel, Inc. (EMD), turned to Argonne National Laboratory for help in identifying ways to reduce locomotive emissions without costly losses in fuel economy.

At the start of the project, Argonne installed a single-cylinder EMD H research engine in one of the Laboratory's high-bay buildings, and later on, a single-cylinder EMD 710 research engine. Using these engines and a variety of diagnostic tools, including laser-based imaging of locomotive-size fuel injector spray, Argonne's engineers worked with EMD and researchers from Wayne State University in Michigan to identify (1) ways for EMD to meet future emissions regulations and (2) methods of introducing new technologies to EMD's locomotive retrofit emissions kit to reduce fuel consumption.

Using a high-speed laser imaging technique, researchers were able to capture real-time images of the fuel spray during fuel injection at 10,000 frames per second with 30-nanosecond exposure time. Being able to characterize fuel spray allows researchers to develop a better understanding of engine performance and emissions.

Benefit

The results of this research help to improve air quality without increasing the railroad industry's fuel-related operating costs or dependence on foreign oil.

A real-time picture of locomotive fuel spray taken during fuel injection, using a high-speed laser imaging technique.