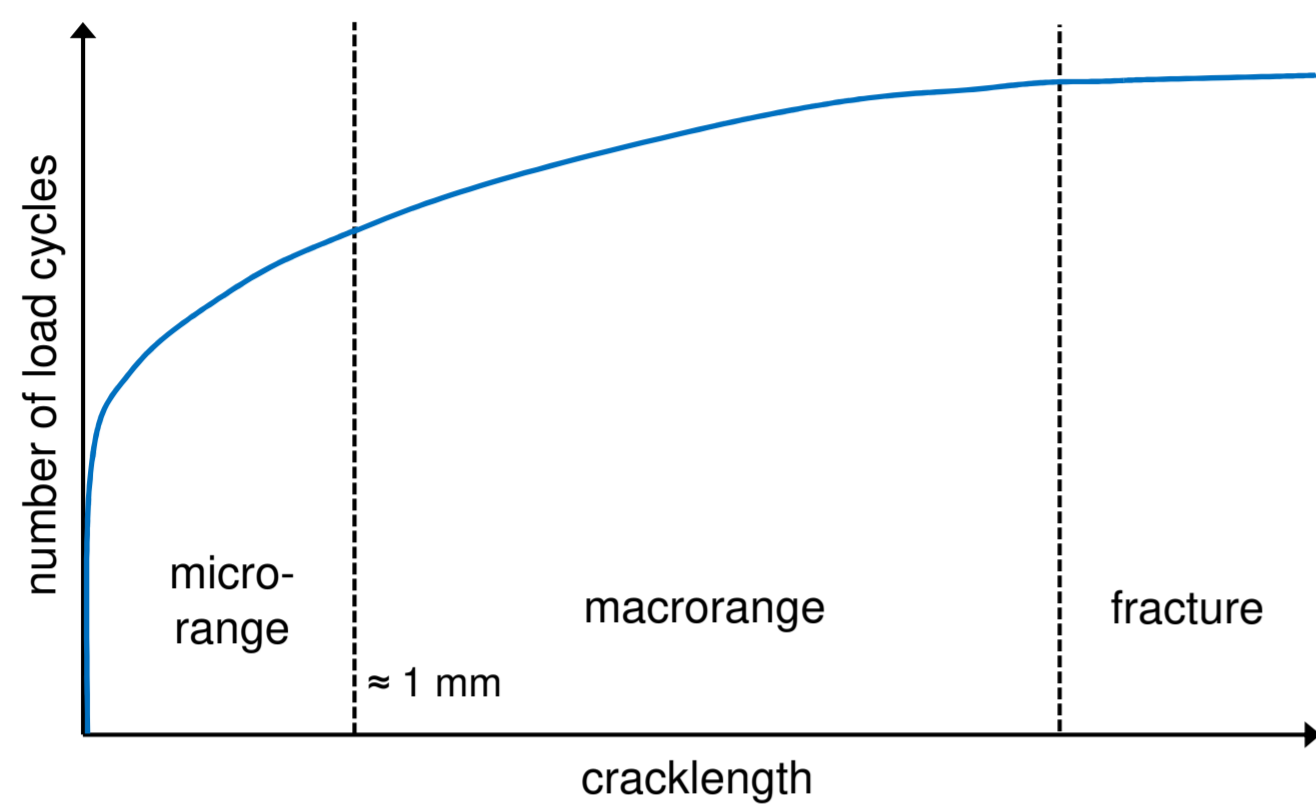


# Detection of micro-cracks in cyclically loaded structural steel by means of full field strain measurements

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## Motivation

Steel bridges are exposed to growing demand due to aging. Damage to structural steel due to aging can often only be detected in an advanced state. In general, if a macro crack is present, a large part of the service life of a component has expired.

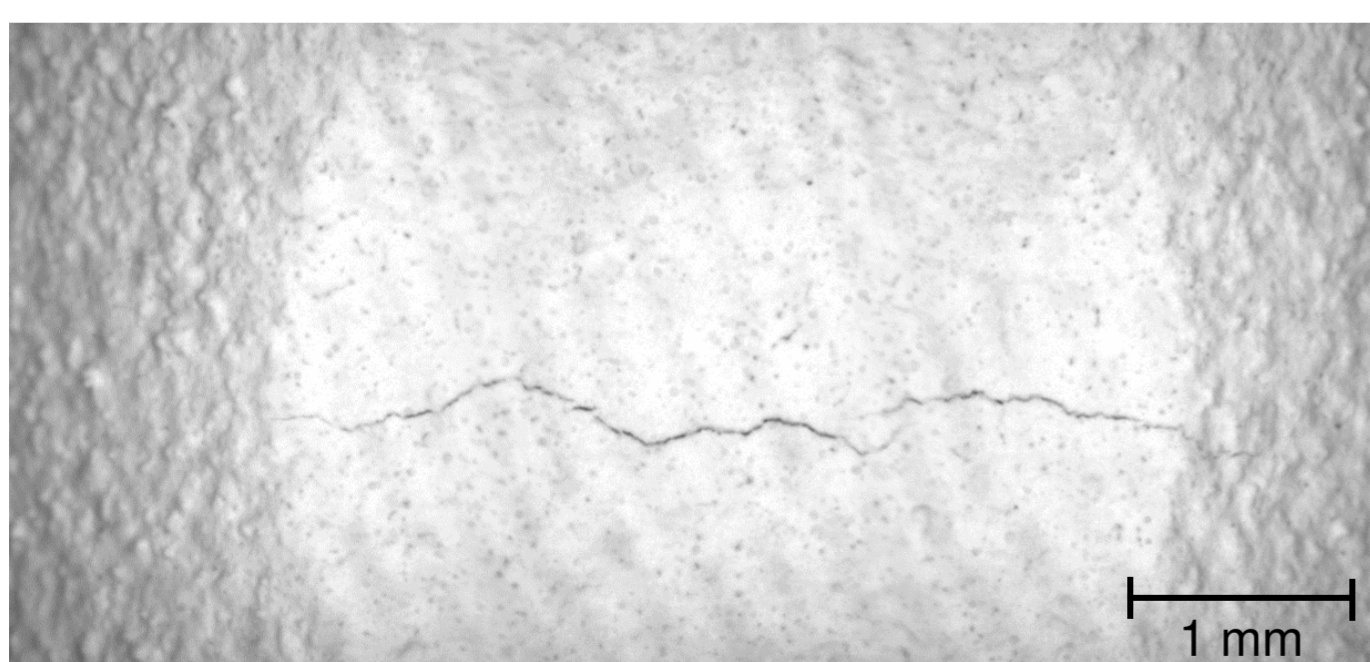


The further the crack grows, the more costly maintenance and servicing becomes. Early detection of damage during the crack initiation can make maintenance more economical and maintain the safe structural condition. Fundamental investigations on the ageing mechanisms in the micro range of structural steel should show whether early detection is possible by means of full-field strain measurements. The investigations represent the starting point for the development of new detection and prediction methods for damage due to aging in structures.

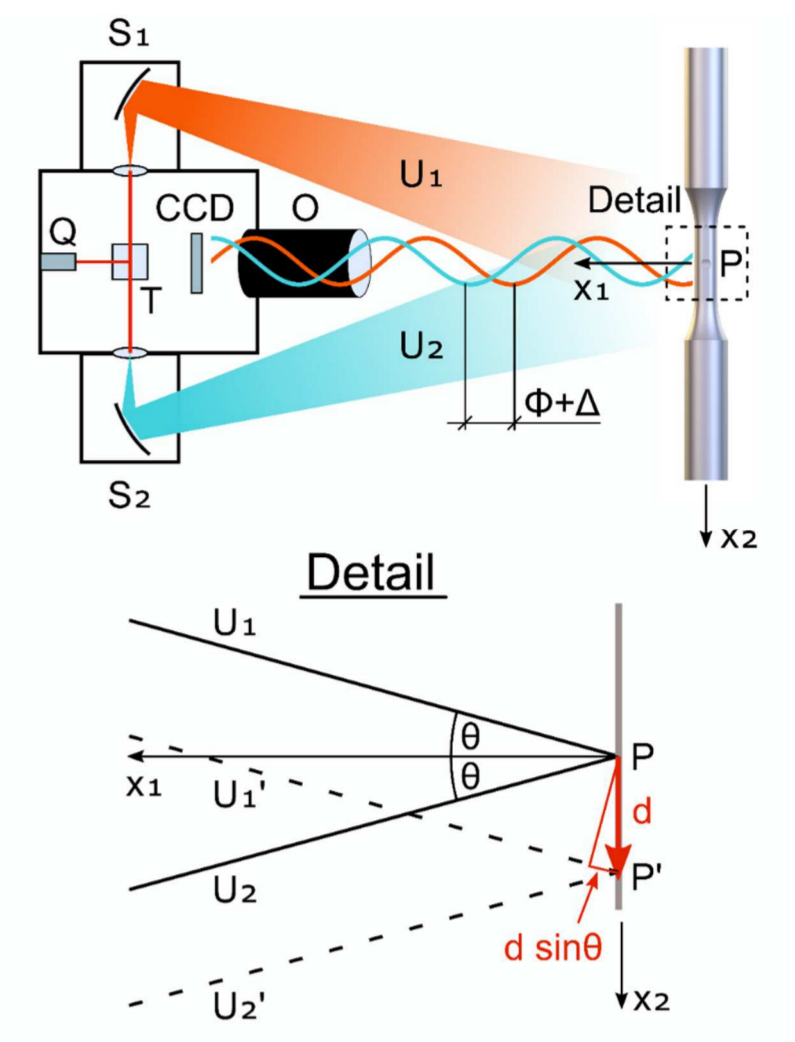
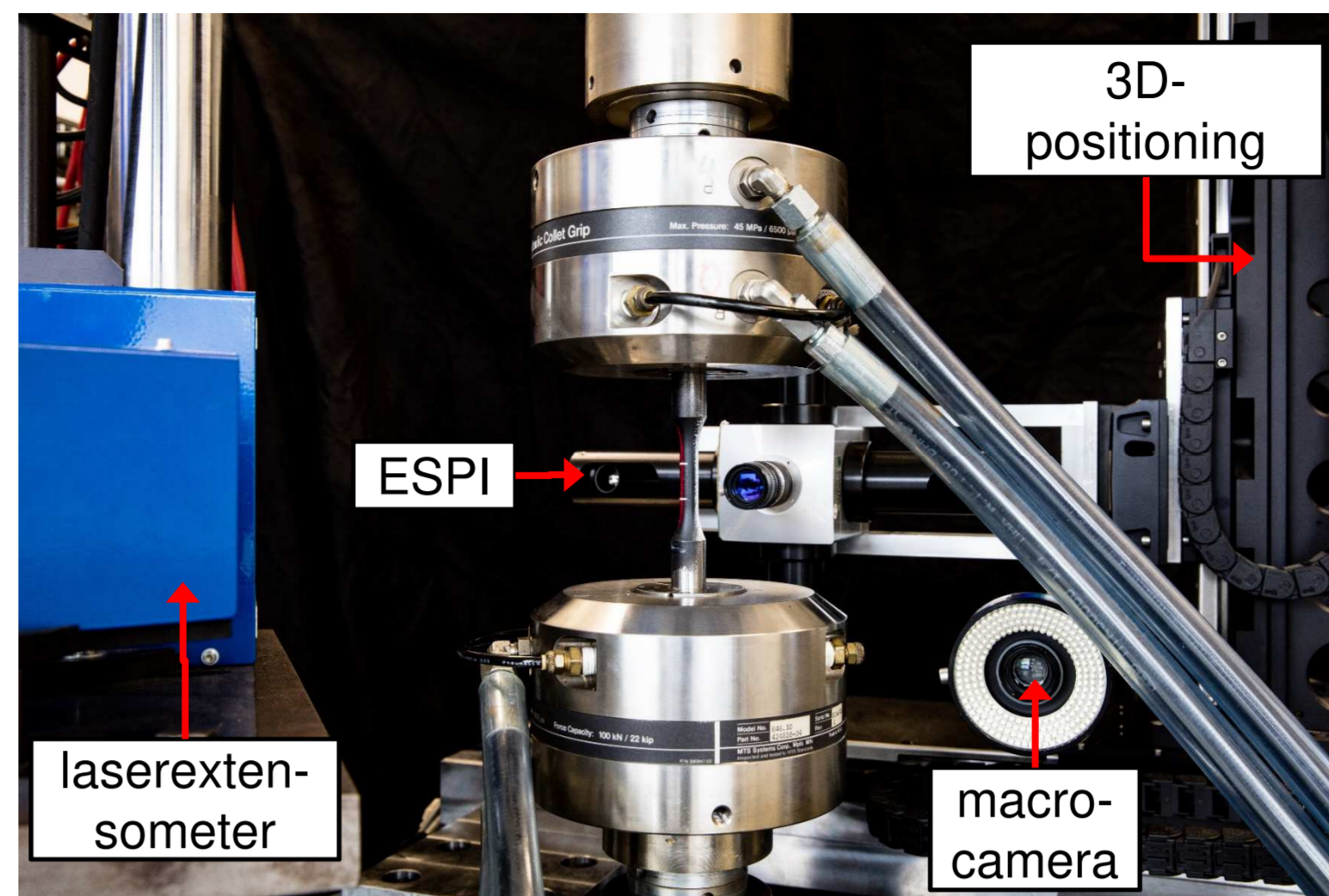
## Results

The detection of the crack is carried out automatically via macro images of the surface parallel to each measurement with the ESPI. The images allow detection of cracks with a length  $l_c$  of approximately 0.2 mm. The crack growth can also be correlated with the propagation of the strain concentration.

In all experiments carried out, the detection of a local strain concentration was possible before a crack was detectable on the surface. In relation to the number of cycles to failure  $N_f$ , the strain concentration is 5% - 15% earlier detectable.

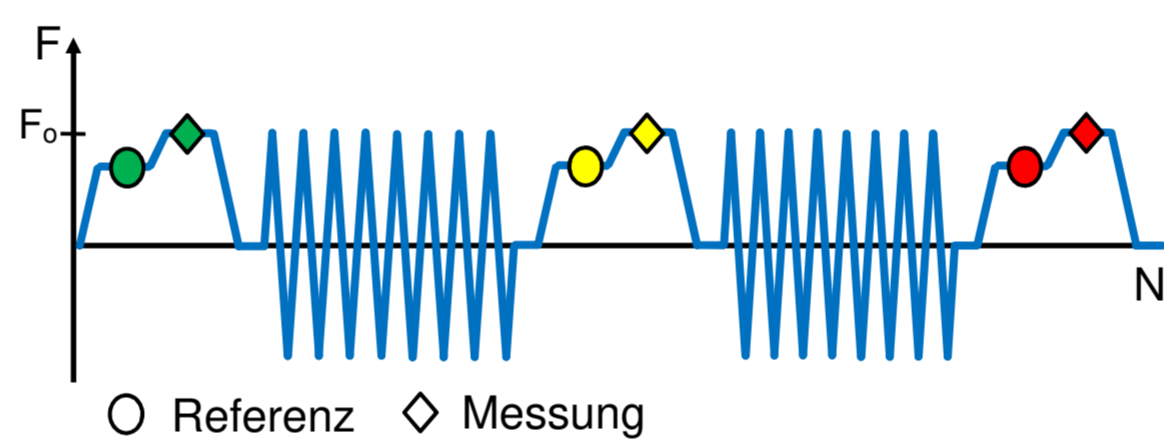


## Test Setup



## Test procedure

Cyclic tests are carried out on samples of S235. Strain measurements and crack detection are performed at the upper load level after every 1000 load cycles.



## Surfaces

ESPI measurements require an optically rough and reflective surface. Two surface finishes were compared:

- lime powder coated
- sandblasted

The lime powder is recommended for easier handling and higher reflectivity.

