An optical-fiber accelerometer based on polarimetric measurements

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Purpose: Dynamic acceleration measurements with optical fibers

Application: Distributed vibration measurements on structures such as bridges, buildings, airplane wings

Method: Variation of the light state of polarization (SOP) within the fiber due to fiber crushing with a mechanical transducer

Basic set-up:
- A single SOP sent within the fiber

Problem:
- Dependency on the input SOP => Unknown sensitivity

New set-up:
- Three SOPs sent within the fiber
- Complete identification of the fiber birefringence properties
  - Without vibration
  - With vibration
- Comparison => independent acceleration measurements

Theoretical Principle:
- SOPs on the Poincaré sphere
  - Without vibration \( x_{10}, x_{20}, \text{ and } x_{30} \)
  - With vibration \( x_{1v}, x_{2v}, \text{ and } x_{3v} \)
- Length of rotation vector \( \Delta b \) between both axes frames proportional to the acceleration amplitude

Experiments:
- Measurements at different acceleration levels
- Measurements with different input SOPs

Results:
- Linear sensor
  - With a single SOP
    - Dependency on the input SOP
  - With three orthogonal SOPs
    - No dependency on the input SOPs