Master Thesis
Fast Strain Measurement for Materials Testing

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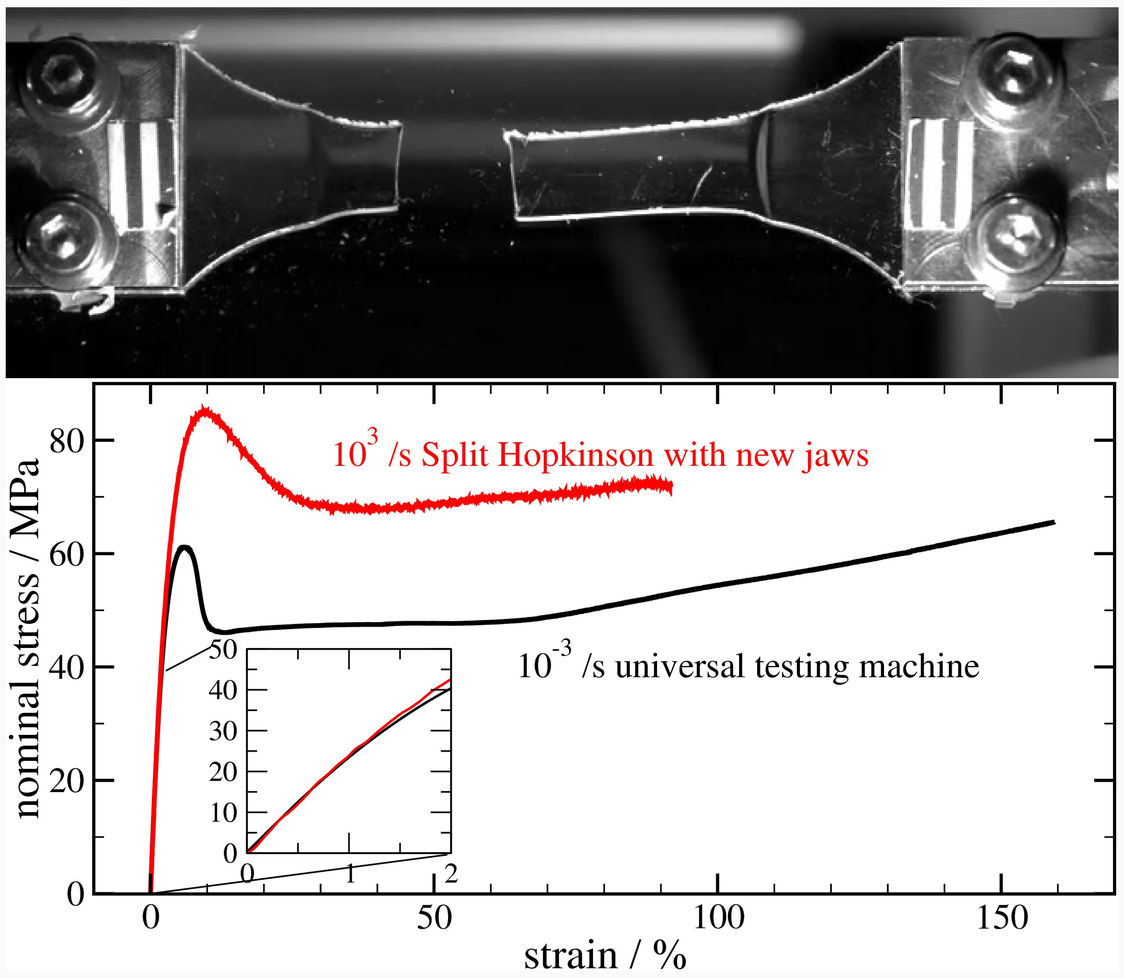
Strain Measurement for Materials Testing

New materials such as polymers or metal alloys need to be thorougly studied before they can be used in actual technical application. This process is termed material characterization and involves mainly the destructive testing of material samples with the aim of recording a stress-strain relationship. From these data, engineering constants such as the Young's modulus or the plastic yield strength are determined. For some materials, these constants depend strongly on the speed at which the material is subjected to loading, an example is shown below for a glassy polymer, which becomes much stronger at higher rates of loading. The knowledge of this *dynamic material behaviour* is crucial for engineering fields such as automotive crash or the aerospace industry. Dynamic material characterization is one of our chair's key research areas.



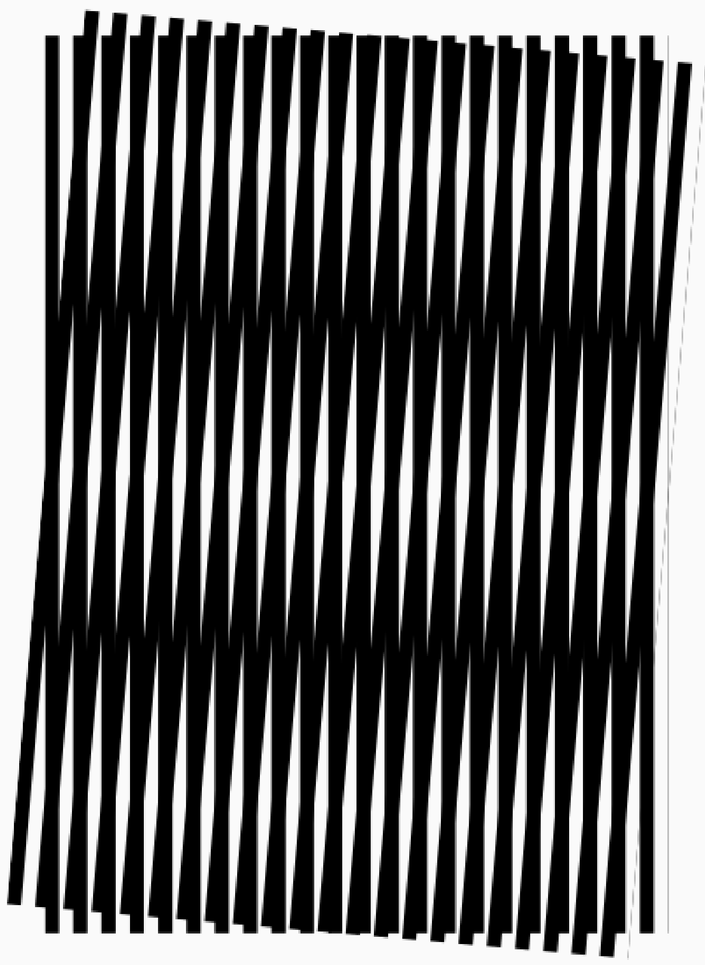
Top: Snapshot of a tensile test of a Polycarbonate specimen, torn apart at high velocity and filmed with a high-speed camera. Bottom: stress-strain data for polycarbonate from our testing laboratory, showing the difference between slow and fast rates of loading.

Challenge Statement

To accurately determine stress-strain relationsships, both force and strain (or displacement) need at be measured with high temporal and/or spatial resolution. We want to develop a sensor system for this purpose, capable of measuring microstrains at Megahertz rates.

Master Thesis Focus

Your task will be to develop a Fourier-based Moiré fringe analysis algorithm which computes displacement from a series of one-dimensional images which record a high-velocity experiment. The resulting computer code will be used at our dynamic material characterisation lab. While the principal approach for solving this problem is already clear, several issues arising from experimental deficiencies of the high-rate optical recordings need yet to be overcome: dealing with noise, uneven exposure, and time synchronization.



Moiré pattern, formed by the superposition of two grids.

Requirements and Offers

You will need good programming skills, ideally with Python. A good mathematical background is helpful, in particular Fourier transforms should not be feared. If this sounds good to you, please get in touch. We offer 40 hours/month employment.

Contact

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