Bulletin
TD2012 A

Tinius Olsen

Video Extensometers

Camera System

Noncontact extensometry is the method of choice for applications where it is especially difficult to measure strain using traditional contacting means. Since these extensometers do not touch the specimen, they are ideal for thin or fragile specimens where contacting alternatives introduce stress points causing premature breaks; where specimens require high temperature or submerged environments; or where specimen failure is accompanied with a huge release of energy.

Tinius Olsen's Video Extensometer uses a high resolution monochrome camera and advanced high speed image processing such that its point-to-point real-time video processing technology is capable of achieving, and exceeding, ASTM E83 Class B1and ISO 9513 Class 0.5 accuracy for both low and/or high strain materials. Continuous measurement through tensile break or compressive rupture, means Tinius Olsen's Video Extensometer is perfect for precise, non-contact measurement of specimen strain.

The system works by acquiring an image of the specimen and using Tinius's pattern recognition technology to lock onto a minimum of two targets, which can equate to a number of different gauge lengths. These targets can be defined by the user, allowing setting these to any gauge length as required. As the specimen is tested, the software tracks the point-to-point movement of these targets from camera frame to frame, and strain data is calculated in real time. Since multiple gauge lengths are possible in both longitudinal and transverse directions, the determination of r and N values is simple and straightforward. The high system resolution required to calculate these results is achieved using subpixel interpolation algorithms and with which the system can resolve to submicron levels of movement.

Fig. 2. Video camera lens being switched to a general purpose lens to allow testing of more elastic materials.

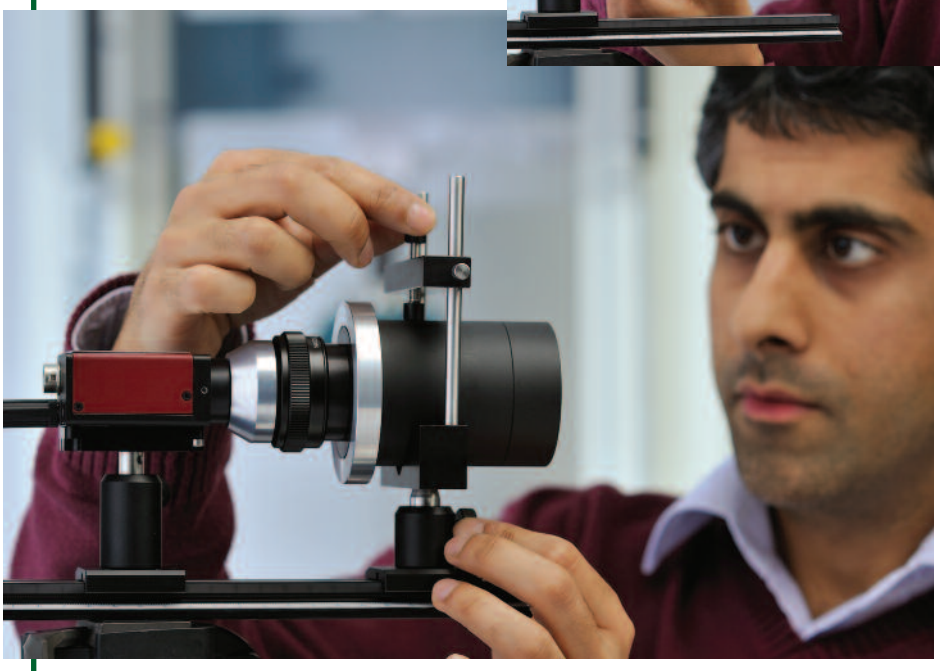


Figure 1. Video camera shown with high resolution materials testing lens.

All the measurements and outputs from the Video Extensometer are time stamped and can be archived for future reference. Additionally, the uncompressed video output from the camera can be recorded for post-test measurements and analysis.

The extensometer is more than capable of following chosen targets in regular daylight conditions, however using additional lighting prevents any tracking loss of target as a result of changes to ambient lighting conditions. Any visible marking can be used for pattern recognition, and these can be natural patterning on the specimen surface, pen marks, blob markers, punched gauge marks or a spray paint speckle pattern. The pattern recognition algorithms work on identification of unique small facets in the video image, so the more inconsistent the pattern, the more accurate and precise the pattern recognition.

The Tinius Olsen Video Extensometer is available in a number of configurations varying by choice of camera lens. The camera itself also comes in multiple configurations, the most popular of which is a 1MP camera with a GigE (also known as Power Over Ethernet, or PoE) interface. Other models of camera differ by frame rate, image sensor size and pixel size. The Video Extensometer can be further enhanced by using multiple camera systems to measure specimen strain. The most typical multi camera configuration consists of two cameras; one with a materials testing lens to precisely track the material during the initial, proportional low strain region of the material's stress strain graph, and a second camera with a general purpose lens to track the material during the plastic, high strain portion of the material's stress strain graph. This capability makes the multi camera system a perfect choice for demanding applications, including metals (such as thin wire) and composites, as well as for complex 3D specimen shapes. The software can track patterns from up to eight cameras.

Camera Lenses

Tinius Olsen can provide many different lenses for a video extensometer system and these lenses fall into two categories, namely a “materials testing” lens and a “general purpose” lens. Materials testing lenses are precision high resolution lenses that have a fixed focal length. General purpose lenses have variable focal lengths with variable, and larger, fields of view. Moving them farther from the specimen increases the amount of strain they can measure.

Materials testing lenses come in a wide range of physical sizes, and because they have a fixed focal length, they must be mounted on one of the many translation stages Tinius Olsen offers, which in turn are mounted on a robust, rigid tripod, or bracketing system mounted to the test frame, which then allow the camera and lens to move backward or forward to bring the specimen and markings into focus.

The Video Extensometer is supplied with application software that allows stand-alone functionality and data transfer to or from a testing machine, Tinius Olsen’s or other. When Tinius Olsen’s Horizon materials testing software is used, the Video Extensometer application software runs in the background and all control, data capture, and analysis is maintained through Horizon. In the case of a multiple camera video extensometer setup, the Video Extensometer application software captures data from all cameras simultaneously but it is the Horizon software that uses data from the camera(s) with the materials testing lens for the initial low strain section, then switches to the camera(s) with a general purpose lens for the remainder of the test. This ensures the highest quality data is used.

Fig. 4. Sample of general purpose lenses.

Figure 5. Selection of materials testing lenses, some shown with different translation stages that support the camera and lens and allow movement for focusing.

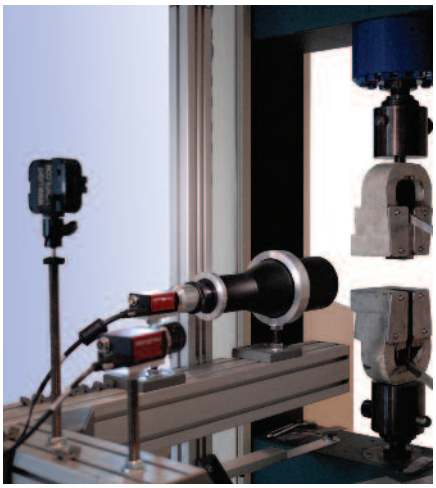
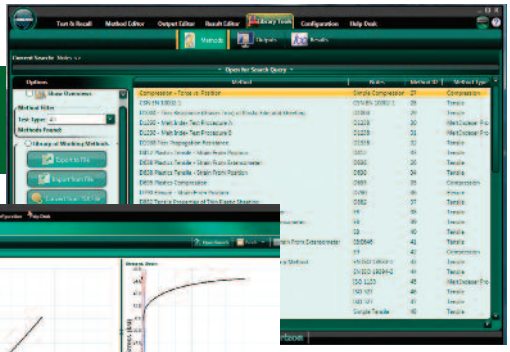


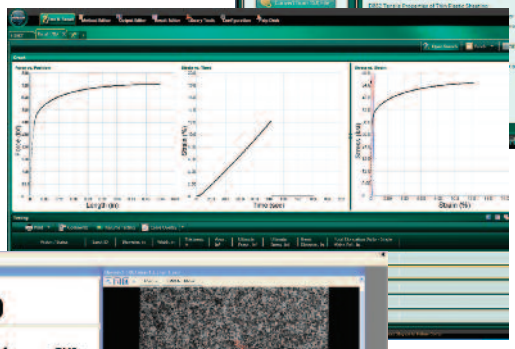
Figure 3. Dual camera setup, one camera with materials testing lens and the other camera with a general purpose lens; also showing mounting bracket and light source (if required).

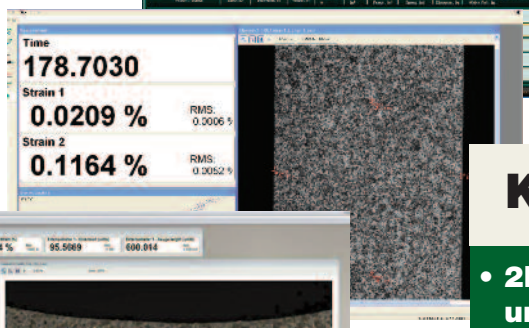
Key Features:

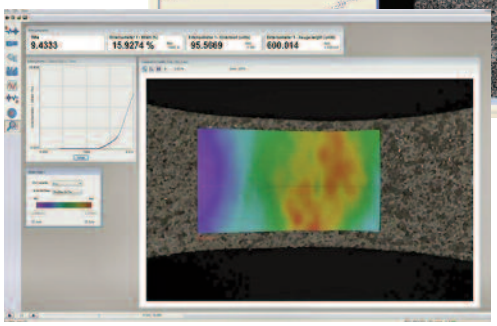
- **Maximize measurement versatility with point-to-point methodology**
- **Measure fragile, brittle, irregular, and other difficult specimens without contact**
- **Meet requirements for ASTM E83 Class B1, ISO 9513 Class 0.5 and EN 10002-4 standards**
- **Choose axial, axial-transverse, orthogonal, rotational measurements**
- **Use multiple cameras and longitudinal gage lengths to study complex events**
- **Integrate measurements into results and reports from Horizon software**
- **Capture and archive video images for later review**

Software









Tinius Olsen has built upon its long history of providing solutions to an enormous variety of testing problems to develop Horizon, a comprehensive software program that makes testing simple, precise, and efficient. Whether the test sample is metal, paper, composite, polymer, rubber, textile, or a micro component, Tinius Olsen's Horizon software goes far beyond data collection and presentation. It will help you automate your operations, from R&D to the charting and analysis of QC testing. Horizon provides a library of standard, specific, and application-focused test routines that have been developed in close cooperation with our customers around the world and to the standards they are using.

Among the many valuable features offered by Horizon are: a test routine library; simultaneous multiple machine control; test, output, method, and result editors; and multilayered security. This software is designed for data acquisition, data analysis, and closed loop control of nearly all Tinius Olsen testing machines.

Horizon is rich with capabilities that improve productivity and enable you to build, access, and use a modern, powerful materials testing database. It employs the latest Windows environments to create an intuitive user experience. Built-in tutorials, on-line help, and help desk access provide additional user support.

Our Video Extensometer software monitors the object under test. By fitting an appropriate lens to the high resolution cameras, the Video Extensometer will measure objects smaller than 1 mm to larger than 100 m. Tinius Olsen's Video Extensometer software uses patented technology to precisely measure 2D position of targets in images from the video camera; special targets are NOT required.

The user identifies these targets to the system simply by using the mouse to drag a bounding box around them. The system then precisely measures each target's position in every image from the video camera. Up to 100 targets can be measured in real-time at 15 Hz. From the measured positions of the targets, the system can calculate displacement, velocity, acceleration, angular rotation, 2D Strain.

Key Features:

- **2D strain map option – understand complex strain distributions with easy-to-use strain mapping tool**
- **3D point-to-point option – make multiple X,Y, and Z displacement measurements in real time**
- **Improved export capabilities**
- **Video overlaid with results, raw results, cropped videos which enable users to view and save what is important**
- **More export options for results, including videos with measurement overlay (including strain maps)**

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