The measurement of strain in triaxial shear tests and the subsequent determination of the key soil parameters (shear modulus, elastic modulus, etc.) is critical to understanding the mechanical behaviour of soils.

Most currently available systems need to set the measuring system directly on the soil sample to be tested, which can disrupt the soil and therefore the results (Cole 1978, Clayton et al. 1989). Thus, some authors have implemented contactless systems, including devices based on the use of a laser spot (eg Romero 1999; Dasari 2002; Messerklinger & Springmann 2007). These devices have the advantage of not requiring contact with the specimen and so do not disrupt the mechanical behaviour of soil.

GDS Instruments integrated the laser heads and receivers into their GDSLAB software (see Figures 3 and 4), to accommodate ENSG testing requirements. The software allowed the laser to measure a point measurement and also scan the sample profile, which could be used to give a measurement volume change. GDSLAB can record a profile scan at a maximum rate of every 5 seconds.

The laser profilers used to measure the distance between the samples and sensor have an accuracy of about ±10μm in optimal conditions of measurement. Alongside the lasers the GDSLAB software allowed complete automated control of the triaxial test to run a suite of tests on the sample.
Results

Figure 2 shows data from part of a profile obtained for a sample as it strains. The red line is the sample at the start of the test, the blue line is the sample at the end of the test stage. The top-cap can be seen at the end stage. From this profile it is possible to estimate the local lateral deformation of the sample at all heights, thus also being able to give information about the current volume of the sample and the way the sample is deforming.

![Profile Diagram]

**Fig 2, Laser profilers shown on sample**

Conclusion

The ability to measure the sample diameter at a point without touching the sample was proved with this method. Further to this, the ability to measure the sample profile, and therefore the sample volume is extremely interesting, especially for applications such as the testing of unsaturated soil where sample volume measurement is extremely difficult to measure via more traditional measurements such as volume of fluid leaving or entering the sample.

The ease at which these profiles can be measured using GDSLAB software makes this an extremely powerful tool. Fig's 3 & 4 are screenshots taken when using the GDSLAB software.

**Fig 3, Screenshot of the laser driver connecting to the GDSLAB Software.**

**Fig 4, Screenshot of the lasers being controlled via the GDSLAB software.**

Testing Equipment Required

- GDSLAB Software
- High-accuracy 2D Laser Displacement Sensor
- Modified Triaxial cell