Light is the fastest and shortest wave providing the best temporal and spatial resolutions. For this reason, optical methods utilizing a full-range of wavelengths from X-Ray to visible lights and infrared have been successfully applied for measurements over a wide range of spatial domain and temporal resolution, not only to make 2D and 3D deformation measurements on the surface, but also to make volumetric measurements throughout the interior of a material body. This track will provide a platform for researchers to exchange ideas and to encourage cross-fertilization of various disciplines.

A total of 64 papers will be presented in the Costa Mesa Meeting regarding the following and other related areas:

- Optical Methods for Measurement at the Micro-Nano Scale
- Bio-engineering & Bio-mechanics
- Advanced Methods for Frontier Applications
- Development in image correlation
- DIC applications
- Volumetric imaging and correlation
- DIC Uncertainty Quantification and Development
- Opto-acoustical Methods in Experimental Mechanics
- Opto-acoustic emissions from fracture and plasticity
- Advanced algorithm for optical methods
- Novel optical methods for strain stress analysis

It is quite interesting to look at the very extensive list of topics mentioned above. Papers include both very important theoretical aspects of optical signal processing that have been under contention for many years. There are also a large number of very valuable applications in a variety of engineering problems of great practical importance including bioengineering/biomedical applications. A very interesting trend is the expansion of optical methods in combination with other areas like acoustics waves, ultrasound, and diverse aspects of microscopy. In the area of materials science, optical methods have a unique contribution to the understanding of constitutive relationships settling controversies that have been around for more than a century. Also optical information retrieval techniques extended to fields other than Optics also provide a very important tool for the diagnosis of different type of pathologies. Finally, a very important area is opening for optical methods applied to a new technology of the future, 3-D printing.

**Track 3: Keynote Presentation**

**Fu-pen Chiang—Stony Brook University (NY)**

**Evolution of Speckle Photography: From Macro to Nano & from 2D to 3D #5**

Tuesday, June 9, 2015 | Session 25

Speckle photography technique for displacement/strain measurement has its genius in a 1968 paper by J. Burch. Over the years it has evolved from using laser speckles as the transducer to using white light speckles. A digital version of the technique was introduced by Chiang’s group in 1993, and its resolution was greatly enhanced by Chiang’s group in 1997 with the use of micro/nano speckles and viewed via an electron microscope. Up to this point the technique is essentially a 2D tool in that only a plane surface’s deformation can be measured (with some difficulty an interior plane’s deformation can also be mapped). Recently we have extended the technique into 3D domain by recording a volumetric image of an solid with the help of a Micro-CT. And the appropriate algorithm using Fourier optics concepts has been developed to process the data. We called this new technique Digital Volumetric Speckle Photography (DVSP). In this paper we trace the route of evolution of this powerful technique and provide examples of application of DVSP to measuring interior strain distribution in rocks and composites.
Track 3: Keynote Presentation
Bing Pan—Beijing University of Aeronautics & Astronautics, China
Comparison of Subset-based Local and Finite Element-based Global Digital Image Correlation #248
Wednesday, June 10, 2015 | Session 46

Subset-based local DIC and finite element-based (FE-based) global DIC are the two primary image matching methods that have been extensively investigated and regularly used in experimental mechanics community. Due to its straightforward implementation and high efficiency, subset-based local DIC has been used in almost all commercial DIC packages. However, it is assumed by some researchers that element-based global DIC offers better accuracy because of the enforced continuity between element nodes. Thus there is a pressing need to comprehensively examine the performance of these two DIC approaches. In this work, theoretical analyses of the standard deviation errors of classic subset-based DIC and two FE-based DIC techniques are first performed. Then, by measuring displacements of the same calculation points using the same calculation algorithms and identical calculation parameters, the performances of subset-based local DIC and two FE-based global DIC approaches are compared experimentally in terms of measurement error and computation efficiency using numerical tests and real experiments. A detailed examination of both the theoretical and experimental results reveals that, when subset (element) size is not very small, standard subset-based local DIC approach not only provides better results in measured displacements, but also demonstrates much higher computation efficiency. However, several special merits of FE-based global DIC approaches are indicated.

Track 3: Keynote Presentation
Alberto Carpinteri—Politecnico di Torino, Italy
Opto-acoustic and Neutron Emissions From Fracture and Earthquakes #193
Thursday, June 11, 2015 | Session 74

TeraHertz phonons are produced in condensed matter by mechanical instabilities at the nano-scale (fracture, turbulence, buckling). They present a frequency that is close to the resonance frequency of the atomic lattices and an energy that is close to that of thermal neutrons. A series of fracture experiments on natural rocks has recently demonstrated that the TeraHertz phonons are able to induce fission reactions on medium weight elements with neutron and/or alpha particle emissions. The same phenomenon appears to have occurred in several different situations and to explain puzzles related to the history of our planet, like the ocean formation or the primordial carbon pollution, as well as scientific mysteries, like the so-called cold nuclear fusion or the correct radio-carbon dating of organic materials.

Very important applications to earthquake precursors, climate change, energy production, and cell biology can not be excluded.