

INTERNATIONAL FEDERATION OF SURVEYORS (FIG)

Commission 6 - Engineering Surveys

Working Group 6.1 – Deformation Measurements and Analysis

**10th INTERNATIONAL SYMPOSIUM ON DEFORMATION
MEASUREMENTS**

Orange, California, USA

19 - 22 March 2001

Hosted by:

The Metropolitan Water District of Southern California (MWD)

United States Geological Survey (USGS)

**Scripps Institution of Oceanography's Orbit and Permanent Array Center
(SOPAC)**

In Co-operation with:

Department of Geodesy and Geomatics Engineering, University of New Brunswick

Corporate Assistance by:

Leica Geosystems

SYMPOSIUM ORGANISING COMMITTEE

of the

10th FIG INTERNATIONAL SYMPOSIUM ON DEFORMATION MEASUREMENTS

Orange, California, USA

19 - 22 March 2001

Chair of the Symposium Organising Committee:

Cecilia Whitaker, Metropolitan Water District of Southern California

Members of the Symposium Organising Committee:

Yehuda Bock, Scripps Institution of Oceanography's Orbit and Permanent Array Center

Adam Chrzanowski, University of New Brunswick

Michael Duffy, Metropolitan Water District of Southern California

Ken Hudnut, United States Geological Survey

Carson Kennedy, Leica Geosystems, Inc.

Symposium Logistics Planner

Kathryn Jurgensen, Premier Meetings, Inc., Irvine, CA

10th International (FIG) Symposium on Deformation Measurements

Orange, California, March 19 – 22, 2001

GENERAL PROGRAM

MONDAY, March 19, 2001

8:45 - 10:30 - Opening Addresses and Keynote Presentations

10:30 - 10:50 - *Coffee Break*

10:50 - 12:20 - Technical Session I **New Techniques in Monitoring Surveys I**

12:20 - 13:30 - *Lunch*

13:30 - 15:00 - Technical Session II **New Techniques in Monitoring Surveys II**

15:00 - 15:20 – *Coffee Break*

15:20 – 16:50 - Technical Session III **Software for Deformation Data Collection, Processing and Analysis**

16:50 – 17:00 – Introduction to Poster Session

18:00 – 20:30 - Reception, Viewing of Poster Papers, Opening of Exhibition

TUESDAY, March 20, 2001

9:00 - 10:30 – Technical Session IV: **Earth Crustal Deformation, Earthquakes, and Regional Movements I**

10:30 - 10:50 - Coffee Break

10:50 - 12:20 – Technical Session V: **Earth Crustal Deformation, Earthquakes, and Regional Movements II**

12:20 - 13:30 - *Lunch*

13:30 – 15:00 - Technical Session VI: **Deformation Monitoring and Modelling of Large Dams**

15:00 – 15:20 - *Coffee Break*

15:20 – 16:50 - Technical Session VII: **Deformation Effects of Mining, Deep Excavations and Oil Withdrawal**

18:30 – 22:00 - *Banquet*

WEDNESDAY, March 21, 2001

9:00 – 10:50 Technical Session VIII: **Structural Deformations**

10:50 – 11:10 – *Coffee Break*

11:10 - 12:40 Technical Session IX: **Theory of Deformation Analysis I**

12:40 – 13:50 – *Lunch*

13:50 – 15:20 – Technical Session X: **Theory of Deformation Analysis II**

15:20 – 15:40 – *Coffee Break*

15:40 – 16:40 - Technical Session XI: **Activity of the FIG Working Group 6.1 on Deformation Measurements**

16:40 – 16:50 - **Closing of the Symposium**

THURSDAY, March 22, 2001

8:00 – 17:00 - **Site Visit to the Automated Monitoring Scheme at the Diamond Valley Lake**

TECHNICAL SESSIONS

Monday, March 19, 2001

8:45 WELCOME

Dr. Adam Chrzanowski, Chairman of the FIG Working Group on Deformation Measurements
Cecilia Whitaker, Chairman of the Organising Committee of the Symposium

9:00 – 10:30 : OPENING SESSION AND KEYNOTE PRESENTATION

Opening Session Keynote Speaker :

Steve Verigin, *California Department of Water Resources, Division of Safety of Dams*

Keynote Technical Presentation:

Automated Monitoring Scheme at Diamond Valley Lake

Cecilia Whitaker, Chris Hill, Mike Duffy – *USA*, Adam Chrzanowski, James Lutes, and Geoffrey Bastin – *CANADA*

COFFEE BREAK

10:50 – 12:20: SESSION I : NEW TECHNIQUES IN MONITORING SURVEYS I

CHAIR: Dr. Chen-Yong-qi – Hong Kong Polytechnical University, P.R. CHINA

Using Satellite INSAR to Detect Potential landslides

K.M. Kosar, S.L. Nichol, and P. Rapp – *CANADA*

Mining Subsidence Monitoring Using the Combined INSAR and GPS Approach

Linlin Ge, Chris Rizos, Shaowei Han - *AUSTRALIA*, and Howard Zebker – *USA*

Applications of Pseudolites in Deformation Monitoring systems

Liwen Dai, Jinling Wang, Chris Rizos, and Shaowei Han – *AUSTRALIA*

High Resolution Topography along the October 16, 1999 Hector Mine Earthquake (MW7.1)

Surface Raptures using Airborne Laser Swath Mapping (ALSM)

K.W. Hudnut, A. Borsa, C. Glennis, and J.B. Minster – *USA*

Application of High-Resolution, Ground- Based Laser Scanner for Deformation Measurements

Stuart Gordon, Derek Lichti, Mike Stewart, and Troy Forward – *AUSTRALIA*

LUNCH

13:30 – 15:00 : SESSION II: NEW TECHNIQUES IN MONITORING SURVEYS II

*CHAIR: Dr. Michel Mayoud – European Organization for Nuclear Research (CERN)
SWITZERLAND*

Steep Wall Monitoring Using Switched Antenna Arrays and Permanent, Multi-Reference GPS Networks

Troy Forward, Mike Stewart, Maria Tsakiri, and Nigel Penna – *AUSTRALIA*

The Measurement of Planar Deformations in Civil Engineering Using Digital Photography and PIV Image Analysis

D.J. White, W.A. Take, M. Morais, and M.D. Bolton – *U.K.*

Application of Photogrammetry in Monitoring of Natural Terrain Landslide and Marine Rubble Structures

Ng Tsan-wing and Leung Kin-Wah, *HONG KONG*

3D Deformation Measurement Using Stereo-Correlation Applied to Experimental mechanics

Dorian Garcia and Jean-José Orteu, *FRANCE*

Dynamic Monitoring of Deforming Structures: GPS versus Robotic Theodolite Systems

R.S. Radovanovic and W.F. Teskey, *CANADA*

Coffee Break

15:20 – 16:50: SESSION III: SOFTWARE FOR DEFORMATION DATA COLLECTION, PROCESSING, AND ANALYSIS

CHAIR: Chris Hill - Metropolitan Water District of Southern California, USA

Epoch-by-Epoch™ Positioning Applied to Dam Deformation Monitoring at Diamond Valley Lake

Yehuda Bock, Paul de Jonge, Michael Bevis, Lydia Bock and Steve Wilson, *USA*

Modern Monitoring System Software Development

Karl Sippel, *SWITZERLAND*

DIMONS Software for Automatic Data Collection and Automatic Deformation Analysis

James Lutes, Adam Chrzanowski, Geoffrey Bastin, – *CANADA*, and C. Whitaker - *USA*

Advances in Real Time GPS Deformation Monitoring for Landslides, Volcanos, and Structures

David Rutledge and Jack Gnipp, *USA*

Development of a Software System for Least Squares Estimation, Deformation Detection and Visualization Analysis

Halim Setan and Bong Chin Nyet – *MALAYSIA*

16:50 – 17:00 : INTRODUCTION TO POSTER SESSION

Mike Duffy – Metropolitan Water District of South California, USA

18:30 – 20:30 : POSTER SESSION (See attached listing)

TUESDAY, March 20, 2001

9:00 – 10:30 : SESSION IV: EARTH CRUSTAL DEFORMATION, EARTHQUAKES, AND REGIONAL MOVEMENTS I

CHAIR: Dr. Yehuda Bock, Scripps Institution of Oceanography's Orbit and Permanent Array

Center (SOPAC)

The Southern California Integrated GPS Network (SCIGN)

Kenneth W. Hudnut, Yehuda Bock, Frank Webb, Bill Young, *USA*

Earthquake Prediction based on Stress or Strain Forecasting Strategy

C.A. Tang – *P.R. CHINA*, X.L. Ding, and Y.Q. Chen – *HONG KONG, P.R. CHINA*

Near Real-Time Deformation in Germany - A Contribution to the German Research Network Natural Disasters (DFNK)

S. Goebell, G.W. Michel, R. Galas, Ch. Reigber - *GERMANY*

GPS Vectors Configuration design for Monitoring deformation Network in the North of Israel

Gilad Even-Tzur – *ISRAEL*

Earth Crustal Deformation Movements in East Slovakia

Vladimir Sedlak – *SLOVAKIA*

Coffee Break

10:50 – 12:20 : SESSION V: EARTH CRUSTAL DEFORMATION, EARTHQUAKES, AND REGIONAL MOVEMENTS II

CHAIR: Dr. Ken Hudnut, United States Geological Survey, USA

Tropospheric Modelling of the regional GPS Deformation Network “Antarctic Peninsula”

M. Mayer and B. Heck – *GERMANY*

Monitoring of Recent Crustal Movements and Earthquake Activity in and around the Greater Cairo Region, Egypt

Abd El-Monem Sayed Mohamed and Ali Tealeb – *EGYPT*

Monitoring Surface Deformation in the Mexicali Valley, B.C., Mexico

E. Glowacka, F.A. Nava, G. Diaz de Cossio, J.J. Gonzales, F. Farfan - *MEXICO*

Kinematic Deformation Analysis of the First Order Benchmarks in the Netherlands

A.J.T. de Bruijne, F. Kensing, and F. Kleijer – *THE NETHERLANDS*

A Possible Improvement of EUREF Coordinate Time Series for Investigation of Crust Deformation in the European Region Using non-Fiducial Strategy

Zinovy Malkin, Alexander Voinov – *RUSSIA*

LUNCH

13:30 – 15:00 : SESSION VI : DEFORMATION MONITORING AND MODELLING OF LARGE DAMS

CHAIR K. Egger- Switzerland

Factors Affecting the Design of Monitoring Schemes for Large Dams

Adam Chrzanowski, G. Bastin, James Lutes, and Anna Szostak-Chrzanowski – *CANADA*

Milliken Dam: Structural Monitoring of a Concrete Arch Dam

John F. Paxton – *USA*

The Extensive Geodetic System Used for the Monitoring of a 185 Meter High Arch Dam in Southern Africa

C. Pretorius, C.S. van Staden, W.F. Schmidt - *SOUTH AFRICA* and K. Egger - *SWITZERLAND*

Use of Geodetic Monitoring Surveys in Verifying Geotechnical Parameters in Large Earthen Dams

Anna Szostak-Chrzanowski, Michel Massiera, Adam Chrzanowski – *CANADA*, and Cecilia Whitaker – *USA*

Field Evaluation of Engineering Geologic Hazards of an Embankment Dam Constructed Across a Major, Active Plate Boundary, Fault

Azm S. Al-Homoud – *UNITED ARAB EMIRATES*

Coffee Break

15:20 – 16:50 : SESSION VII: DEFORMATION EFFECTS OF MINING, DEEP EXCAVATIONS, AND OIL WITHDRAWAL

CHAIR: Dr. A. Szostak-Chrzanowski, University of New Brunswick, CANADA

Studies of Displacements of GPS Stations in Polish Copper Basin Area

A. Wasilewski, Z. Rzepecka, and S. Oszczak - *POLAND*

The Monitoring of Ground Subsidence due to Oil Extraction in Western Venezuelan Oilfields

Juan Murria, *VENEZUELA*

Behavior of Drilled Shafts in Sandy Soils of United Arab Emirates

Al-Homoud – *UNITED ARAB EMIRATES*, T. Fouad, and A. Mukhtar – *EGYPT*

Application of Surveying Techniques for Monitoring and Appraisal of Excavated China Clay Slopes

J.S. Coggan – *U.K.*, D.Stead - *CANADA*, and J.H. Howe – *U.K.*

Geotechnical and Structural Measurements for a Deep Excavation near an Existing Navigable Lock

J. Kayser and R. Schwab – *GERMANY*

WEDNESDAY, MARCH 21, 2001

9:00 – 10:50 : SESSION VIII: STRUCTURAL DEFORMATIONS

CHAIR: Dr. H. Kahmen, University of Technology Vienna, AUSTRIA

Deformation Measurement on Bridge and Tunnel which Makes up the Fixed Link Between Sweden and Denmark

Svend Erik Breumson, *DENMARK*

The Use of Kinematic GPS and Triaxial Accelerometers to Monitor the deflections of Large Bridges

G.W. Roberts, X. Meng, A.H. Dodson – *U.K.*

Erecting the Inclined Pylon Legs in a Cable-Stayed bridge with the Support of Strain and Stress Analysis

W. Proszynski and A. Stanczyk - *POLAND*

Toward the Implementation of an On-line Structural Monitoring Using RTK-GPS and Analysis of results Using the Wavelet Transform

Clement Ogaja, Chris Rizos, Jinling Wang – *AUSTRALIA*, and James Brownjohn – *SINGAPORE*

Stability and Deformation Analysis of Large Electron Positron Collider in CERN

Fengxiang Jin – *P.R. CHINA*, Michel Mayoud, and Jean-Pierre Quesnel – *SWITZERLAND*

Deformation Survey for the Preservation of Lei Cheng Uk Han Tomb

NG Tsan-wing and Leung Kin-wah – *HONG-KONG, P.R. CHINA*

Coffee Break

11:10 – 12:40 : SESSION IX : THEORY OF DEFORMATION ANALYSIS I

CHAIR: Dr. Walter Welsch, Bundeswehr University Munich, GERMANY

Deformation Analysis with Modified Kalman-Filters

Sinisa Mastelicivic – *CROATIA* and H. Kahmen - *AUSTRIA*

Modelling of Landslides Based on Monitoring Data and Dynamics of Slopes

X.L.Ding, Y.Q. Chen, J.J. Zhu, and K.T. Chau – *HONG KONG, P.R. CHINA*

Identification of Physical Parameters by Means of Differential Equations in the Adaptive Dynamic Filter Model

Andreas Eichhorn, Wolfgang Möhlenbrink – *GERMANY*

Trend Signal Modelling of Land Subsidence

F. Kenselaar - *THE NETHERLANDS*

Information Pattern Recognition Theory and its Application in Deformation Analysis

Fengsiang Jin – *P.R. CHINA*, Michel Mayoud – *SWITZERLAND*, and Zhixing Du – *P.R. CHINA*

LUNCH

13:50 – 15:20 : SESSION X : THEORY OF DEFORMATION ANALYSIS II

CHAIR: Dr. W. Proszynski, Warsaw Technical University, POLAND

Importance of Autocorrelation for Parameter Estimation in Regression Models

Heiner Kuhlmann – *GERMANY*

Optimal Design of Geodetic Monitoring Networks by Means of Interval Mathematics

Steffen Schön and Hansjörg Kutterer - *GERMANY*

An Integrated Model for Physical Interpretation of Deformations

I.Milev and L. Gruending - *GERMANY*

Models for the Prediction of Lateral Deformations of the Land in Function of the Coefficients of Pressure

W. Naime and C. Osio – *VENEZUELA*

Identifying Multiple Outliers in Linear Regression: Robust Fit and Clustering Approach

Halim Setan, Mohamed Nor Mohd, and Robiah Adnan – *MALAYSIA*

Coffee Break

15:40 – 16:50 : SESSION XI: ACTIVITY OF THE FIG WORKING GROUP 6.1 ON DEFORMATION MEASUREMENTS AND CLOSING REMARKS

CHAIR: Adam Chrzanowski – CANADA

Report on the Activity of FIG WG 6.1

A. Chrzanowski - *CANADA*

Models and Terminology for the Analysis of Geodetic Monitoring Observations Official Report of the ad hoc Committee of WG6.1

W.M. Welsch and O. Heunecke - *GERMANY*

Plenary Discussion on the Future Activity of FIG WG6.1

Closing of the Symposium

Adam Chrzanowski

POSTER PAPERS

(LISTED IN THE ALPHABETICAL ORDER OF THE FIRST AUTHOR)

Monitoring and Analysis of Settlement and Stability of an Embankment Dam Constructed in Stages on Soft Ground, Azm AL-HAMOUD, United Arab Emirates

Deformation of the Turbo-blocks in the Power Plant Villa de Reyes, San Luis Potosi, Mexico, Javier Zuniga ARRIOLA, Mexico

Dam Deformation Monitoring in Developing Countries – A Case Study, Geoff BASTIN, Adam CHRZANOWSKI, and James LUTES – Canada

Recent Movements of earth Crust in the Sudety Mountains – GEOSUD Project, Stefan CACON, Poland

Optimization of the Best Alternative Method's Objective Function, Slawomir CELLMER, Poland

Airborne Positioning in Polish Aviation with GIS – Special Topics, Andrzej FELLNER, Poland

San Rafael Dam Spillway Piles Deformations, Ma. Guadalupe Barrios GALVAN, Mexico

Accuracy Estimation of the Engineering Construction deformation Determined on the Basis of Analytical geometry, Ryszard GRABOWSKI, Poland

Monitoring of Horizontal Displacements in European Coalfields, Ryszard HEJMANOWSKI and Andrzej KWINTA, Poland

GPS-based Online Control and Alarm System (GOCA), Reiner JAGER, Germany

A Testing Procedure for Subsidence Analysis, F. KENSELAAR, The Netherlands

Tectonic Movements Monitoring of Sudetic Marginal Fault Using Short GPS Baselines, Bernard KONTNY, Poland

Use of Satellite GPS Technique in the Measurements of deformations in the Areas of Mining Exploitation, Jadwiga MACIASZEK and Jacek SZEWCZYK, Poland

Some Results of Investigation of the Local Geodetic Network at the Observatory Swetloe, Zinovy MALKIN and Alexey KAZARINOV, Russia

Monitoring of Brick Buildings Deformations Caused by Uneven Deformation of Background, Krzysztof MROCZKOWSKI, Poland

The Influence of a Strong Mining Tremor on the Surface Subsidence in the Legnica-Glogow Copper Basin, Edward POPIOLEK, Janusz OSTROWSKI, Jozef CZAJA, and Jan MAZUR, Poland

Viaduct Of Verrieres, Gps Special Survey Of The Roadway Under Construction, Cyril ROMIEU, Jacques BEILIN, Thierry PERSON, France

Automated GPS Monitoring at Genewash Dam, California, David RUTLEDGE, Michael DUFFY, Cecilia WHITAKER, Steve WILSON, USA

Stage 1 of Subsidence Monitoring of the Area Surrounding Salto Caxias Power Dam in Brazil, Marcelo SANTOS, Camil GEMAEL, Pedro FAGGION, Claudia KRUEGER, Luis FERREIRA, Marco SOARES, and Anna SZOSTAK-CHRZANOWSKI, Canada/Brazil

Use of Apparent resistivity Tides Variations for Seismic Activity Monitoring, Alexandert SARAEV, Mikhail PERTEL, AND ZINOVY MALKIN, Russia

Basement Deformation of a Multi-Stories Dwelling in Different Types of Foundation, TANG Yongjin and HE Jinhua, P.R. China

Registration Information

Full registration includes all technical sessions, one copy of the proceedings (CD-ROM), book of abstracts and handouts, lunches, coffee breaks, Monday evening exhibitor hosted reception, and Tuesday evening cultural event.

Student (full time graduate or undergraduate) registration includes all technical sessions, book of abstracts and handouts, lunches, coffee breaks and Monday evening exhibitor hosted reception.

Accompanying person registration includes lunches, coffee breaks, Monday evening exhibitor hosted reception, and Tuesday evening cultural event.

Exhibitors

Companies interested in being an exhibitor should contact our conference organizer directly for information and exhibitor kit. Please email your request for information to Kathryn Jurgensen at kathryn@premiermeetings.com. Exhibitor registration includes a 10' x 10' exhibition space for exhibit starting Monday evening through all day Tuesday and includes one full registration.

Costs

Full registration (postmarked and paid by November 15):	\$375 US
Full registration (postmarked and paid after November 15):	\$450 US
Student registration: dollars	\$175 US
Accompanying person registration: dollars	\$150 US
Tour to Diamond Valley Lake and San Andreas Fault:	\$35 US
Extra copy of proceedings (CD-ROM):	\$50 US

Symposium Hotel Information

Please call Premier Meetings, our housing agent, directly to make your reservations. To guarantee that you receive the discounted rate, be sure to make your reservation before January 1, 2001 and identify yourself as attending the 10th FIG Symposium. There are limited rooms available for smoking guests, so please reserve your room early if this is preferred. Please use the form below for making reservations.

DoubleTree Hotel (symposium location):

Address: 100 The City Drive, Orange, California, USA, 92868

Rate: \$99 US dollars plus tax/night/room includes complimentary continental breakfast

Hotel deposit: 1 night stay (\$99 US dollars plus 10.1% hotel tax = \$109)

Parking: self parking available on a complimentary basis

Airport Shuttle/Taxis: are available from all airports, average cost \$25 -35

Shuttles: shuttles to area attractions are available at the hotel

Registration Information, Hotel Reservation and Payment Form

Name: _____

Organization: _____

Mailing Address: _____

City, State, Postal Code, Country: _____

Phone: _____ Fax: _____ e-mail: _____

Full registration (postmarked and paid by November 15):	\$375	_____
Full registration (postmarked and paid after November 15):	\$450	_____
Student registration:	\$175	_____
Accompanying person registration:	\$150	_____
Excursion to Diamond Valley Lake and San Andreas Fault:	\$35/person	_____
Extra copy of proceedings (CD-ROM):	\$50 each	_____
Hotel deposit (\$99 + 10.1% tax = \$109)(due by Jan 1, 2001)	\$109/room	_____

REGISTRATION TOTAL: _____

HOTEL RESERVATIONS

All choices are \$99 US dollars per night plus 10.1% hotel tax.

- Single (One bed, One person) Arrival Date: _____
- Double (One bed, Two persons) Departure Date: _____
- Double/Double (Two beds, Two persons)
- Smoking Non-Smoking

PAYMENT INFORMATION

Mail To: Premier Meetings, Attn. Kathryn Jurgensen, CMP
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