

[There is also a ‘column’ by John Dunnycliff at the beginning of each episode, except 28 and 33. The column introduces the article(s) in that episode and includes other topical content]

| <b>GIN Episode</b> | <b>Date</b>    | <b>Pages</b>               | <b>Author(s)</b>   | <b>Title</b>   |
|--------------------|----------------|----------------------------|--|--|
| 28                 | September 2001 | 30-35                      | John Dunnycliff<br>Alan Powderham  | Recommendations for Procurement of Geotechnical Instrumentation and Field Instrumentation Services                     |
| 33                 | December 2002  | 38-42                      | P. Erik Mikkelsen  | Cement-Bentonite Grout Backfill for Borehole Instruments   |
| 34                 | March 2003     | 47-50                      | Andrew M. Ridley   | Recent Developments in the Measurement of Pore Water Pressure and Suction  |
|                    |                | 50-53                      | Thomas Thomann<br>Aaron Goldberg<br>Richard Napolitano                           | Are Those Pore Pressure Readings Correct?  |
|                    |                | 53-58                      | Daniel Naterop   | Some Recently Developed Instrumentation Technologies   |
| 35                 | June 2003      | 41-51                      | Barrie Sellers<br>John Dunnycliff<br>P. Erik Mikkelsen<br>Martin Beth            | Discussions of “Measurement of Pore Water Pressures in Embankment Dams”, by Arthur D.M. Penman.<br>Also Author’s Reply |
|                    |                | 51-59                      | Charles H. Dowding<br>Matthieu L. Dussud<br>William F. Kane<br>Kevin M. O’Connor | Monitoring Deformation of Rock and Soil with TDR Sensor Cables   |
| 36                 | September 2003 | ‘Column’ only, no articles |  |  |
| 37                 | December 2003  | 29-30                      | Ralph B. Peck  | The Power of Observation   |
|                    |                | 30-31                      | Youssef Hashash<br>Camilo Marulanda  | Temperature Correction and Strut Loads Interpretation in Central Artery Excavations                                    |
|                    |                | 32-37                      | A. Tyson Kaempffer   | Update on Bentonite Chips and Pellets for  |

|    |                |        |  |  |
|----|----------------|--------|--|--|
|    |                |        |  | Sealing Piezometers in Boreholes   |
| 38 | March 2004     | 31-34  | Jostein Aasen<br>Robert D. Holtz               | A New Geotextile Strain Gage   |
| 39 | June 2004      | 29-31  | W. Allen Marr<br>Barry Christopher             | Test Your Knowledge of Geotechnical Instrumentation  |
| 40 | September 2004 | 21-27  | Michael Long<br>Chris Menkiti<br>Ben Follett   | Some Experiences in Measuring Pore Water Pressure in Dublin Glacial Till   |
|    |                | 27-28  | John Dunicliff                                 | Discussion of "Some Experiences in Measuring Pore Water Pressure in Dublin Glacial Till" by Long, Menkiti, Follett |
|    |                | 28- 31 | Beto Ortigao<br>Maria G. Justi                 | Rio-Watch: the Rio de Janeiro Landslide Alarm System   |
| 41 | December 2004  | 33-35  | R.K.S. Chan<br>W.K. Pun                        | Landslip Warning System in Hong Kong   |
|    |                | 35-40  | Robert Farrell<br>Pedro de Alba<br>Jean Benoît | Piezometer Design and Installation for Earthquake Pore Water Pressure Measurement                                  |
| 42 | March 2005     | 26-27  | Michael Long<br>Chris Menkiti<br>Ben Follett   | Authors' Closure, "Some Experiences in Measuring Pore Water Pressure in Dublin Glacial Till"                       |
| 43 | June 2005      | 30-32  | Barrie Sellers                                 | The Truth About Accuracy   |
|    |                | 32-35  | John Dunicliff                                 | Reminiscences of a Director of Instrumentation Courses   |
|    |                | 35-36  | Gord McKenna                                   | Erroneous Readings   |

|    |                |       |  |   |
|----|----------------|-------|--|---|
|    |                |       |  | from a Vibrating Wire Piezometer With a Broken Signal Wire  |
|    |                | 37    | Simon Cornwallace<br>Barrie Sellers  | Discussions of “Erroneous Readings from a Vibrating Wire Piezometer With a Broken Signal Wire” by McKenna   |
| 44 | September 2005 | 27-31 | Matthew Spriggs<br>Neil Dixon  | The Instrumentation of Landslides Using Acoustic Emission   |
|    |                | 32    | Gord McKenna   | Protecting Instruments from Damage  |
| 45 | December 2005  | 44-47 | David R. Rutledge<br>Steven Z. Meyerholtz  | Using the Global Positioning System (GPS) to Monitor the Performance of Dams                                |
|    |                | 48-51 | Claus Ludwig<br>Etienne Constable  | Wireless Tiltmeters Monitor Stability during Trench Excavation for Reno Transportation Rail Access Corridor |
|    |                | 51-55 | Lyne Daigle  | Temperature Influence on Earth Pressure Cell Readings   |
| 46 | March 2006     | 32-36 | Ali Asghar Mirghasemi  | Karkheh Dam Instrumentation System – Some Experiences   |
|    |                | 36-40 | Ton Peters   | Comparing Surface Settlement Systems for On-Line Monitoring   |
|    |                | 41-43 | Elmo DiBiagio<br>Kaare Høeg  | Where Has All the Judgment Come From?   |
|    |                | 44-45 | John Dunicliff   | Articles in Geotechnical News. March 2003 – March 2006  |
| 47 | June 2006      | 34-43 | Donald Babbitt<br>Elmo DiBiagio<br>Louis Marcil<br>Erik Mikkelsen<br>Arthur Penman<br>Barrie Sellers<br>John Dunicliff | Discussions of “Karkheh Dam Instrumentation System – Some Experiences” by Mirghesemi. Also Author’s reply   |

|    |                |       |  |   |
|----|----------------|-------|--|---|
|    |                | 43-45 | Bengt Fellenius  | Piled Foundation Design – Clarification of a Confusion  |
|    |                | 46-47 | Gord McKenna   | Rules of Thumb for Geotechnical Instrumentation Costs   |
|    |                | 48-50 | Barrie Sellers   | Electrical Cables for Geotechnical Instrumentation Applications   |
| 48 | September 2006 | 30-33 | Gary Holzhausen<br>Louis Marcil<br>Rick Monroe<br>Arthur Penman<br>Barrie Sellers<br>Robert Taylor | Responses to ‘Umbrella’ Questions about Manufacturers and Users Working Together                              |
|    |                | 33-37 | Chris Rasmussen  | Experiences Gained from the Installation of Cable-free Sensors for Geotechnical and Structural Monitoring     |
|    |                | 37-38 | Verne McGuffey   | Interpreting Unexpected Instrument Data   |
| 49 | December 2006  | 35-42 | Helmut Bock  | Discussion of “Karkheh Dam Instrumentation System – Some Experiences” by Mirghesemi. Also Author’s reply      |
|    |                | 42-45 | David Cook   | Robotic Total Stations and Remote Data Capture: Challenges in Construction                                    |
|    |                | 46-49 | Nicole Metje<br>David Chapman<br>Chris Rogers<br>Philip Henderson<br>Martin Beth                   | Smart Rod Tunnel Monitoring System  |
| 50 | March 2007     | 30-33 | Villy Kontogianni<br>Stefi Kornarou<br>Stathis Stiros  | Monitoring with Electronic Total Stations: Performance and Accuracy of Prismatic and Non-Prismatic Reflectors |
|    |                | 33-38 | Martin Beth<br>Brian Dorwart<br>Richard Flanagan<br>Trevor Greening                                | Discussions of “Robotic Total Stations and Remote Data Capture:   |

|    |                   |                            |   |  |
|----|-------------------|----------------------------|---|--|
|    |                   |                            | Douglas Roy and<br>Neils Jensen<br>David Rutledge     | Challenges in<br>Construction” by<br>Cook. Also Author’s<br>Reply  |
| 51 | June 2007         | ‘Column’ only, no articles |   |  |
| 52 | September<br>2007 | 24,25                      | Gord McKenna  | GIN and John.<br>Celebrating 50 Issues<br>of GIN   |
|    |                   | 27-31                      | Daniele Inaudi<br>Branko Glisic                       | Overview of Fiber<br>Optic Sensing<br>Technologies for<br>Geotechnical<br>Instrumentation and<br>Monitoring      |
|    |                   | 31-35                      | Daniele Inaudi<br>Branko Glisic                       | Distributed Fiber<br>Optic Sensors: Novel<br>Tools for the<br>Monitoring of Large<br>Structures                  |
| 53 | December<br>2007  | 32-36                      | J. F. Baker   | Choice of a Strain<br>Gauge  |
|    |                   | 36-38                      | W. Allen Marr   | The Seventh<br>International<br>Symposium on Field<br>Measurements in<br>Geomechanics<br>(FMGM-2007),<br>Wrap-up |
|    |                   | 39                         | Elmo DiBiagio   | The FMGM Web<br>Site: <a href="http://www.fmgm.no">www.fmgm.no</a> .<br>An Update                                |
| 54 | March<br>2008     | 32,33                      | Barrie Sellers<br>Robert Taylor                       | MEMS Basics  |
|    |                   | 33-36                      | Thomas Sheahan<br>David Mazzei<br>John McRae          | Performance Testing<br>of MEMS-based Tilt<br>Sensors   |
|    |                   | 36-40                      | Tarek Abdoun<br>Victoria Bennett                      | A New Wireless<br>MEMS-based System<br>for Real-time<br>Deformation<br>Monitoring                                |
|    |                   | 41-44                      | Matthew Barendse                                      | Field Evaluation of a<br>MEMS-based Real-<br>time Deformation<br>Monitoring System                               |
| 55 | June 2008         | 30-37                      | Ivan Contreras<br>Aaron Grosser<br>Richard Ver Strate | The Use of the Fully-<br>grouted Method for<br>Piezometer  |

|    |                |       |  |  |
|----|----------------|-------|--|--|
|    |                |       |  | Installation. Parts 1 and 2  |
|    |                | 38-40 | John Dunicliff   | Discussion of “The Use of the Fully-grouted Method for Piezometer Installation”. Also Authors’ Reply |
|    |                | 40-44 | Kevin O’Connor   | Geotechnical Alarms Systems Based on TDR Technology  |
| 56 | September 2008 | 28-30 | Colin Hope<br>Marcelo Chaqui                               | Manual Total Station Monitoring  |
|    |                | 30-33 | W. Allen Marr  | Monitoring Deformations with Automated Total Stations  |
|    |                | 33-36 | Lars Krangnes  | Monitoring Norway’s Largest Potential Rockslide  |
| 57 | December 2008  | 23-26 | Peter Bennett  | Distributed Optical Fibre Strain Measurements in Civil Engineering                                   |
|    |                | 26,27 | Joel Volterra  | Monitoring by Manual and/or Automated Optical Survey   |
|    |                | 28-30 | Erik Mikkelsen<br>John Dunicliff                           | Some Views on a Recent Addition to our Instrumentation Tool Box- the ShapeAccelArray (SAA)           |
| 58 | March 2009     | 35-37 | Youssef Hashash<br>Camilo Quinones-Rozo<br>David Groholski | Tracking of Excavation Activities by Laser Scanning and Large Image Reasoning-based Techniques       |
|    |                | 38-40 | Chih-Ping Lin  | TDR as a Geo-Nerve: a Slope Monitoring System Example  |

|    |                |       |   |   |
|----|----------------|-------|---|---|
| 59 | June 2009      | 33-34 | Daniel S. Webber  | In Support of the Fully-grouted Method for Piezometer Installation                                |
|    |                | 34-37 | Nick Osborne<br>G. H. Tan   | Factors Influencing the Performance of Strain Gauge Monitoring Systems                            |
| 60 | September 2009 | 31-34 | Emily B. Dail<br>Joel L. Volterra                                   | Instrumentation and Monitoring Trends in New York City and Beyond                                 |
|    |                | 35    | John Dunnycliff   | Review of “Uncertainty and Ground Conditions – a Risk Management Approach” by Martin van Staveren |
| 61 | December 2009  | 34-36 | W. Allen Marr   | Reasons for Monitoring Performance with Geotechnical Instrumentation                              |
| 62 | March 2010     | 24-26 | Ian Froggatt<br>Maurice O’Neill<br>Steven Turner                    | Remote Monitoring of Loads in Rock Anchors – Process and Benefits                                 |
| 63 | September 1010 | 20-23 | Craig Johnson   | Retrospective Instrumentation of a Concrete Dam   |
|    |                | 24-27 | Carlos Rodrigues<br>Daniele Inaudi<br>Francois Juneau<br>Éric Pinet | Miniature Fiber-Optic MOMS Piezometer   |
| 64 | December 2010  | 25-28 | David Cook  | Fundamentals of Instrumentation Geotechnical Database Management – Things to Consider             |
|    |                | 29-32 | Alexander M. Puzrin<br>Michael Iten<br>Dominik Hayswirth            | Advanced Geotechnical Applications of Distributed Fiber-Optic Sensing                             |

|    |               |       |  |  |
|----|---------------|-------|--|--|
| 65 | March<br>2011 | 29-33 | Roberto Acerbis<br>Harry Asche<br>Guido Barbieri<br>Tiziano Collotta | Recommendations<br>for Converting Strain<br>Measured in Concrete<br>to Stress                      |
|    |               | 34    | Roger Chandler   | The Web of<br>Dissemination of<br>Monitoring Data  |
|    |               | 35    | Angus Maxwell  | INSITE Web Based<br>Data Management<br>Software  |
|    |               | 36    | Alex Neuwirt   | Multilogger Suite<br>Web-based Data<br>Management  |
|    |               | 37    | Rob Nyren  | iSiteCentral Web-<br>based Data<br>Management<br>Software  |
|    |               | 38    | Andres Thorarinsson  | Web-based Data<br>Management<br>Software   |
|    |               | 39    | Hai-Tien Yu  | ARGUS Web-based<br>Data Management<br>Software   |
|    |               | 40    | Rob Taylor   | GeoViewer™ Web-<br>based Data<br>Management<br>Software  |
| 66 | June 2011     | 23-25 | John Dunicliff   | Who Should be<br>Responsible for<br>Monitoring and<br>Instrumentation<br>During Construction?      |
|    |               | 25-28 | Paolo Mazzanti   | Displacement<br>Monitoring by<br>Terrestrial SAR<br>Interferometry for<br>Geotechnical<br>Purposes |
|    |               | 29    | Martin Beth  | Geoscope Web-based<br>Data Management<br>Software  |
|    |               | 30    | Daniele Inaudi   | SHMLive Web-based<br>Data Management<br>Software   |
|    |               | 31    | Rick Monroe  | Atlas Web-Based<br>Data Management<br>Software for<br>Instrumentation                              |



|    |                   |       |  |  |
|----|-------------------|-------|--|--|
| 67 | September<br>2011 | 20    | Brian Tigani<br>Rolando Rongo                    | Interchangeability of<br>MEMS Digital<br>Inclinometer Probes   |
|    |                   | 21    | Damien Tamagnan<br>Martin Beth                   | Monitoring of<br>Surface Deformation<br>with Robotic Total<br>Stations Using<br>Reflectorless<br>Measurements                      |
| 68 | December<br>2011  | 24-26 | Ton Peters                                       | Report on the<br>Symposium on Field<br>Measurements in<br>GeoMechanics<br>(FMGM 2011)<br>Berlin, Germany, 12-<br>15 September 2011 |
|    |                   | 26-29 | Garrett Bayrd                                    | Evaluating Practices<br>for Installation of<br>Vibrating Wire<br>Piezometers   |
|    |                   | 30-33 | Bill Shefchik<br>Reynold Tomes<br>Riccardo Belli | Salt Cavern<br>Monitoring System<br>for Early Warning of<br>Sinkhole Formation   |
|    |                   | 34    | John Dunnicliff                                  | Book Review –<br>Monitoring<br>Underground<br>Construction. A<br>Practical Guide.<br>British Tunnelling<br>Society.                |
| 69 | March<br>2012     | 23-25 | Mike Devriendt                                   | Trigger levels for<br>displacement<br>monitoring   |
|    |                   | 26    | John Dunnicliff                                  | Remote monitoring<br>of deformation.<br>Introduction   |
|    |                   | 27    | Matthew J. Lato                                  | Remote monitoring<br>of deformation using<br>Terrestrial Laser<br>Scanning (TLS or<br>Terrestrial LiDAR)                           |
|    |                   | 28    | Paolo Mazzanti                                   | Remote monitoring<br>of deformation using<br>Terrestrial SAR<br>Interferometry<br>(TInSAR, GBInSAR)                                |

|    |                |                            |  |  |
|----|----------------|----------------------------|--|--|
| 69 | March 2012     | 29                         | Rob Nyren, Ryan Drefus, Sean Johnson                       | Remote monitoring of deformation using Robotic Total Stations (RTS)  |
|    |                | 30                         | Damien Tamagnan, Martin Beth                               | Remote monitoring of surface deformation with Robotic Total Stations using reflectorless measurements (RRTS) |
| 70 | June 2012      | 20-25                      | Ivan A. Contreras, Aaron T. Grosser, Richard H. Ver Strate | Update of the fully-grouted method for piezometer installation   |
|    |                | 26                         | Francesca Bozzano, Alfredo Rocca                           | Remote monitoring of deformation using Satellite SAR Interferometry  |
|    |                | 27                         | Raul Fuentes<br>Stuart Robson                              | Remote monitoring of deformation using Digital Photogrammetry  |
|    |                | 28                         | Jason Bond<br>Rob Nyren                                    | Remote monitoring of deformations using Differential Global Positioning System (D-GPS)                       |
|    |                | 29                         | John Dunnycliff  | Book Review – ICE Manual of Geotechnical Engineering   |
| 71 | September 2012 | ‘Column’ only, no articles |  |  |
| 72 | December 2012  | 24-29                      | Paolo Mazzanti   | Remote monitoring of deformation. An overview of the seven methods described in previous GINs                |
|    |                | 29-32                      | M.W. Grabinsky<br>B.D. Thompson<br>W.F. Bawden             | Field monitoring for improved mine backfill systems  |
| 73 | March 2013     | 24-26                      | Marcelo Chuaqui<br>Wing Lam                                | Field monitoring challenges. Episode 1 Unforeseen piling details and damage to inclinometer casing           |

|    |                |       |   |   |
|----|----------------|-------|---|---|
| 74 | June 2013      | 26-27 | Christopher J. Hill<br>Pierre Choquet                       | USSD presents workshop on state-of-the-art monitoring technologies                                |
|    |                | 28-30 | Marcelo Chuaqui<br>Wing Lam                                 | Field monitoring challenges, Episode 2 Unforeseen movements (depth and magnitude)                 |
|    |                | 30-34 | John Dunnycliff   | Some on-line sources of information about geotechnical instrumentation                            |
| 75 | September 2013 | 27-30 | Margaret M. Darrow  | Automated MEMS-based In-place Inclinometers   |
|    |                | 30-32 | Anonymous   | Lessons learned from unexpected events in the field   |
| 76 | December 2013  | 29-33 | Jason DeJong,<br>Aravinthan Thurairajah,<br>Mason Ghafghazi | A reusable instrumented test pile for improved pile design  |
|    |                | 33-34 | Storer J. Boone   | Discussion of: "Field monitoring challenges, Episode 2 Unforeseen movements (depth and magnitude) |
| 77 | March 2014     | 32-35 | Chris Fagen,<br>Charlie Daugherty                           | The Laser-Distometer: A newer, better way to measure tunnel deformations                          |
| 78 | June 2014      | 23-26 | Derrick Dasenbrock  | Performance observations of MEMS ShapeAccelArray (SAA) deformation sensors                        |
|    |                | 27-28 | Robert Bachus   | Advances in geotechnical data management and visualization  |
| 79 | September 2014 | 22-25 | Glenn Tofani  | Resolving unexpected monitoring results – Two case histories                                      |

|    |               |       |   |   |
|----|---------------|-------|---|---|
| 80 | December 2014 | 35-38 | Simon Maddison  | The fundamentals of wireless monitoring – Things to consider  |
|    |               | 38-41 | Glenn Tofani  | Widespread misconceptions involving liquid or vapor flow in geotechnical monitoring applications  |
| 81 | March 2015    | 28-34 | Francesca Bozzano   | Lesson learned from two case histories about the planning of integrated monitoring systems  |
|    |               | 34-36 | Raymond D’Hollander, Paul Roth, Shane Blauvelt James O’Loughlin | The use of fully-grouted piezometers in a streambed   |
| 82 | June 2015     | 17-21 | Marc Smith  | Performance of ShapeAccelArray (SAA) for settlement monitoring of a large rockfill dam  |
|    |               | 21-22 | Adam Dulmage and Matt Trenwith                                  | Discussion of “The fundamentals of wireless monitoring – things to consider” by Simon Maddison. Geotechnical News, Vol. 32, Number 4, December 2014 |
|    |               | 23    | Simon Maddison  | Response/Closure  |
| 83 | Sept 2015     | 19-22 | David K. Cook and Thijs Claus                                   | Lessons learned during removal of instrumentation after 13 years of monitoring at a large urban tunneling project                                   |

|    |               |       |                                |  |
|----|---------------|-------|--------------------------------|--|
| 84 | December 2015 | 30-33 | Douglas Roy and Jonathan Stuhl | Qualifications of the robotic total station construction monitoring professional   |
|    |               | 33-34 | Donald Shields                 | Giving credit where credit is due  |
|    |               | 35-37 | John Dunnicliff                | General role of instrumentation, and summaries of instruments that can be considered for helping to provide answers to possible geotechnical questions, Part 1 |
| 85 | March 2016    | 25-27 | Bob Turnbull                   | The fundamentals of vibration monitoring – things to consider  |
|    |               | 27-31 | Martin Beth & Joel Volterra    | Discussions of “Qualifications of the robotic total station construction monitoring professional”  |
|    |               | 31-32 | Douglas Roy & Jonathan Stuhl   | Authors’ reply   |
|    |               | 32-34 | John Dunnicliff                | General role of instrumentation, and summaries of instruments that can be considered for helping to provide answers to possible geotechnical questions. Part 2 |
|    |               | 34-35 | Andrew Ridley                  | Report on 9 <sup>th</sup> Symposium on Field Measurements in Geomechanics  |
|    |               | 35-36 | Andrew Ridley                  | The future of FMGM   |
| 86 | June 2016     | 20-22 | Martin Beth                    | Eight common sense rules for successful monitoring   |
|    |               | 23-26 | Vincent Le Borgne              | Lessons learned in vibration monitoring  |

|    |                |       |  |   |
|----|----------------|-------|--|---|
| 86 | June 2016      | 27-31 | John Dunnicliff  | General role of instrumentation, and summaries of instruments that can be considered for helping to provide answers to possible geotechnical questions. Part 3  |
| 87 | September 2016 | 18-19 | John Dunnicliff  | General role of instrumentation, and summaries of instruments that can be considered for helping to provide answers to possible geotechnical questions. Part 4. |
| 88 | December 2016  | 20-22 | John Dunnicliff  | Introduction  |
|    |                | 22-25 | Alister Smith, Neil Dixon, Daniela Codeglia, Gary Fowmes | An acoustic emission slope displacement rate sensor: Comparisons with established instrumentation   |
|    |                | 25-29 | Vincent Le Borgne  | Monitoring a heritage building restoration project with geotechnical instrumentation  |
|    |                | 29-30 | John Dunnicliff  | General role of instrumentation, and summaries of instruments that can be considered for helping to provide answers to possible geotechnical questions. Part 5. |
| 89 | March 2017     | 35    | John Dunnicliff  | Introduction  |
|    |                | 36-38 | Colin Hope & Stephen Dawe                                | Manual reflectorless total station monitoring (MRTS)  |
|    | June 2017      |       | No Articles  |   |

|    |                   |       |  |   |
|----|-------------------|-------|--|---|
| 90 | September<br>2017 | 20    | John Dunnycliff  | Introduction  |
|    |                   | 21-23 | Isabella Ramaccia and<br>David Cook  | System Checks/Validations<br>A practical approach for<br>displacement monitoring  |
|    |                   | 23-27 | Zhangwei Ning and<br>Marc Fish   | A case study of Global<br>Navigation Satellite<br>System (GNSS) in<br>landslide ground<br>movement monitoring   |
|    | December<br>2017  |       | No articles  |   |
| 91 | March<br>2018     | 36    | John Dunnycliff  | Introduction  |
|    |                   | 37-38 | Francois Duhaime,<br>Vahid Merefat,<br>Robert P. Chapuis,<br>Vincent Le Borgne | Fully grouted piezometers<br>in a soft Champlain clay<br>deposit. Update on the<br>article in the Groundwater<br>section of September 2017<br>issue of Geotechnical<br>News |
|    |                   | 38-40 | Garrett Bayrd  | Extract/Transform/Load<br>(ETL) processes for<br>instrumentation data<br>transfer   |