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First Annual Report of the Centre for Computational Geostatistics

JANUARY 1999

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- *Declustering with Seismic or “Soft” Geological Data*, C. V. Deutsch, P. Frykman, and Y. Xie
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- *Methodology for Improved Variogram Interpretation and Modelling for Petroleum Reservoir Characterization*, E. Gringarten and C. V. Deutsch
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- *Facies Modelling Accounting for the Precision and Scale of Seismic Data: Application to Albacora Field*, G. Schwedersky, M. Cortez, M. F. Lopes, and C. V. Deutsch
- *A Short Note on Cross Validation of Facies Simulation Methods*, C. V. Deutsch
- *Reservoir Management Decision Making in Presence of Uncertainty: A Progress Report*, P. Cruz
- *A Short Note on Geostatistical Scaling Laws Applied to Core and Log Data*, P. Frykman and C. V. Deutsch
- *FORTTRAN Programs for Calculating Connectivity of 3-D Numerical Models and for Ranking Multiple Realizations*, C. V. Deutsch
- *Well Placement Using Geo-Object Connectivity of Multiple Realizations: Methodology and Program*, B. Wang, C. V. Deutsch, and M. AlHarbi
- *A Training Course for GSLIB in PowerPoint*, M. Pyrcz and C. V. Deutsch
- *A Short Note on GSLIB 2.90: An Updated FORTRAN 90 Version with Dynamic Memory Allocation*, D. Preheim and C. V. Deutsch

Introduction

It has been a challenge launching a new industrial affiliates program during times of record low energy and commodity prices. Budgets are being cut and mergers of unprecedented size are taking place. In spite of these pressures, I am pleased to introduce the first annual report of the *Centre for Computational Geostatistics (CCG)*.

The Centre started with six members. The support of these founding members is greatly appreciated. The objective of this report is to demonstrate unquestionable value to those members and to provide an enticement to potential members. Moreover, this report sets the standard and the “tone” for future reports. Although a single data point hardly constitutes evidence of a trend, I expect this report to set a trend of consistent research into the application of computational methods in geostatistics. Time will tell.

Research has been conducted in two main directions: *data integration* and *decision making in presence of uncertainty*. In general, future research will continue in these two directions. Junior students will make incremental advances in these areas and, hopefully, deliver interesting algorithms, code and case studies. Senior students and permanent researchers will strive for breakthrough advances in methodology. Most research is focused toward petroleum reservoir characterization. Diversification into related subjects of mining, geotechnical, environmental, agriculture and biotechnology are anticipated; however, the interests of CCG members will always be given high priority. At present, support is from the petroleum industry.

This report presents a number of interesting contributions in the field of computational geostatistics. Although results are presented in many areas of geostatistical reservoir modelling, the focus is on facies modelling (1) a critical review of the available techniques to honor geologic structures, (2) introduction of surface modelling methods to permit an improved ability to honor stratigraphic structures, which constitutes a new approach to complement classical object-based and cell-based approaches, (3) refinements to the *fluvsim* program for fast well conditioning, (4) development of an object-based approach to deepwater depositional systems, and (5) software for indicator simulation that uses block cokriging for “rigorous” integration of seismic data.

The papers in this report are approximately ordered according to the stage in a geostatistical study that the methodology would be applied; declustering at the beginning and management of multiple realizations at the end. The order of presentations at the annual meeting will be different. Additional papers and material will also be presented at the annual meeting in Edmonton. An update will be distributed.

An important hallmark of the CCG is close contact with industry and research into problems of practical importance. Focus on deepwater depositional systems is an example. Deepwater systems are currently an important geologic setting for exploration and production. Also, many of the papers in this report are the result of collaboration with industrial sponsors. I would wish that this collaboration increase and extend to less active CCG members.

In addition to the classical research deliverables such as methodologies, algorithms, case

studies, and computer code, the CCG delivers one other significant *product* to its members: people. Some students will continue to work in research; however, there is significant demand for students to move into professional roles where they conduct application studies, develop software, train other professionals, test and verify software and methods, and embark upon various other numerical geological modelling endeavours. A promising group of students, well versed in the theory and practice of geostatistical modelling, is “in the pipeline.” Summer students and graduates will be moving into the industry in the near future.

A number of people have asked about the relationship between the CCG and the Stanford Center for Reservoir Forecasting (SCRF). The relationship between SCRF and CCG is essentially a personal relationship between André Journel and myself. We remain close friends. André has been involved in all aspects of my professional career and has been part of my family. Notwithstanding this close personal friendship, there is no financial agreement nor is there any direct sharing of research results or code between SCRF and myself. This separation is necessary for organizations to justify membership in CCG. Who would join if everything were to be delivered through SCRF anyway? Although I guard the distinction between SCRF and myself jealously, André and I have plans to continue joint development of GSLIB for a third edition, to be published in 2002 (tentative).

This report is one deliverable that would justify membership in CCG. Although a hard copy report will be generated each year as a consolidation of the year’s research, the main deliverable will be an electronic copy of the report, computer code, and all related material. The contents of this year’s CD-ROM:

report	electronic copies of all papers and figures
progs	source code of all programs used in report
gslib90	source code and executables of FORTRAN 90 GSLIB
gslib_course	PowerPoint Slides for GSLIB Short Course

Support for the Centre for Computational Geostatistics is modest. The students and researchers at the CCG are just starting in geostatistics. Nevertheless, I am pleased with the research results that have been collected in this report. Thank you for participating in the growth of the geostatistical community.

Clayton V. Deutsch

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CCG Staff / Researchers / Students

Following are people at the University of Alberta who are affiliated with the Centre for Computational Geostatistics. There are numerous contacts in member companies who contributed in significant ways to the results presented in this report. They are prominently acknowledged in the author lists of each paper.

Rebecca L. Anderson: full time Summer Intern from April 1998 to September 1998 and part time since then working on upcoming monograph on Production Data Integration

Clayton V. Deutsch: Associate Professor of Civil & Environmental Engineering and Director of CCG

Karl P. Norrena: M.Sc. student working on decision making in the presence of uncertainty

Bora Oz: Ph.D. student working on scaling relationships in presence of complex geologic structures

David M. Preheim: full time Summer Intern from April 1998 to September 1998; largely responsible for conversion of GSLIB to F90

Michael J. Pyrcz: Research Assistant coordinating the annual meeting; largely responsible for PowerPoint GSLIB course among other research activities

Zulfiqar A. Reza: Ph.D. student working on the integration of historical production data in geostatistical reservoir models

Bujin Wang: Ph.D. student who developed well site selection algorithm, but has not chosen thesis subject

Xuesi Wang: new Ph.D. student who has not chosen thesis subject

YuLong Xie: Postdoctoral Fellow dedicated to full time research toward improved geostatistical modelling of petroleum reservoirs