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ABSTRACT (Continue on reverse if necessary and identify by block number)

This initial report provide a summary outline of (a) the current status of the work, (b) the set of investigations underway, and (c) future research plans.

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1. Scientific Work Completed.

(a) Review of database support and update of CAMPS.

We are currently investigating the scope of introducing (relational) database facility, [1, 2, 3], within our Computer Assisted Mathematical Programming (Modelling) System (CAMPS), [4]. Based on comments and criticisms of our earlier system, the external (user) specification is under revision. In revising the interface we have taken into account the work of EDS, PLANETS [5], Meeraus et al, GAMS [6] and that due to Carmona, SIMP [7]. We plan to introduce a modern user interface, such as window tools, for system control aimed at modellers with no programming skill. An additional support system, that is programmer's interface, is also planned. CAMPS is a program generator system. With this interface non-standard modelling applications may be constructed by analysts. An IBM-PC implementation is planned for June 1987.

(b) Investigation of methods for representing nonlinear, integer, and fuzzy programming problems.

We have investigated methods by which nonliner functions which are not variable separable may be, after suitable algebraic manipulation, put in a variable separable form. While not concerning ourselves with the most computationally efficient representation of nonlinear function for optimisation, we have endeavoured to create a general algebraic representation leading to computer support for the modeller. We have already created partial computer support for special ordered sets of type one and type two.

Preliminary investigations of techniques to transform logical restrictions to 0-1 mixed integer programs and fuzzy linear programming reformulation methods are also under way. At the next stage we expect to prepare a specification suitable for implementation.

(c) Computer assisted analysis

Currently, we are investigating the integration of the system with a computer assisted analysis system, ANALYZE, due to Greenberg [8]. We have a working version and a full description of this system and are generally examining the scope of pre-analysis of the model before optimisation. This, in the short term, involves us in learning fully, how to use the system. The MPSX naming schemes used by the system are incorporated in our new version. We are also redesigning our run-time library and generated program so that our internal data-structure is consistent with that of ANALYZE. This should then allow us to internally use ANALYZE subroutines to carry out pre-analysis of models.

2. Research Plans.

The research plans over the next two years are as follows:

(a) Construct a revised and streamlined implementation of the CAMPS modelling system, with enhanced screen based interface.

(b) Design and implement reformulation support for integer, fuzzy and nonlinear programs.

(c) Integrate the model generation system with model analysis system and introduce database management support.

3. Administrative change.

None

4. Other information.

(i) A paper describing the essential CAMPS system has been prepared and is accepted for publication in Computer Journal [9].

(ii) Theoretical aspect of reformulation methods and described in another paper [10].

5. Financial Annex.

See next page

23 February 1987
REPORT1

REFERENCES:

1. Date, C J, An Introduction to Database Systems, Addison-Wesley, London, 1981.

2. Bonczek, R, Holsapple, C, and Whinston, A, Mathematical Programming within the context of a Generalised Database Management System, RAIRO, Vol 12, No 2, 1978.

3. Welsh, Jr. J S, PAM-A Practitioner's Approach to Modelling presented at ORSA/TIMS Joint National Meeting, Miami Beach, 1986.

4. Lucas, C, and Mitra, G, Computer Assisted Mathematical Programming (Modelling) System: CAMPS, User Reference Manual, Brunel University, 1985.

5. Lucas, J, Expert System/Mathematical Programming applied to strategic decisions, developed by Electronic Data System (EDS), presented to TIMS XXVII, Gold Coast, Australia, 1986 and winner of Franz Edelman award for Management Science Achievement, TIMS, 1986.

6. Bisschop, J, and Meeraus, A, On the Development of a General Algebraic Modelling System in Strategic Planning Environment, Mathematical Programming Study 20, 1982, North Holland.

7. Carmona, J, and Jones, C, SIMP, Spreadsheet Interface to Mathematical Programming User's Guide, Department of Management Systems and Sciences, The University of Hull, 1986.

8. Greenberg, H J, A Functional Description of ANALYZE: A Computer - Assisted Analysis System for Linear Programming Models, ACM Transactions on Mathematical Software, Vol. 9, No. 1, 1983.

9. Lucas, C, and Mitra, G., Computer Assisted Mathematical Programming (Modelling) System: CAMPS, to be published in the Computer Journal, UK.

10. Lucas, C, Mitra, G, Yadegar, J, and Darby-Dowman, K, Linear, Integer, Separable and Fuzzy Programming Problems: A Unified Approach Towards Reformulation, to be published in the JORS, UK.

1. Scientific work completed

(a) Update of CAMPS: Experimental work

A new specification of CAMPS has been prepared [1]. This is currently being implemented and tested on an IBM PC and it is expected that this version will be ready by June 1987. The internal data structure has been redesigned to produce a compact and compatible form. We have bought and tested some Window software [2], which allows us to create an acceptable user interface.

(b) Investigation of methods for representing nonlinear, integer and fuzzy programming problems.

We have prepared a formal specification [1] to represent non linear problems by

(i) Special ordered sets of type one and two [3]

(ii) 0-1 representations of logical variables.

(c) Computer assisted analysis or models

We are at the preliminary stage of integrating CAMPS and ANALYZE [4] and have redesigned the run time data structures which are used by computer programs generated by CAMPS. These programs are used for model generation, analysis and are required to be consistent with the data structure of ANALYZE.

We are also working on a user specification for model analysis, and expect to complete this task by September 1987.

2. Research plans

The research plans over the next two years are as follows:

(a) Implementation and development of revised CAMPS, including a support function for programmer's interface.

(b) Integration of reformulation support for integer, fuzzy and nonlinear programs within CAMPS.

(c) Inclusion of detailed model and solution analysis tools in CAMPS.

3. Administrative change

None

4. Other information

(i) A paper describing the preliminary integration of CAMPS with ANALYZE has been accepted for publication in a special issue of the IMA journal of Mathematics in Management [4].

(ii) We are also contributors to a NATO Advanced Study Institute Programme, titled International Advanced Course on Mathematical Models for Decision Support. This takes place in July, and we will also be providing a workshop on the use of CAMPS.

5. Financial annex

See next page.

REFERENCES

[1] Lucas, C., and Mitra, G., Computer Assisted Mathematical Programming (Modelling) System: CAMPS, User Reference Manual, Brunel University, Version 2, 1987.

[2] Lattice Curses Screen Manager, Lattice Inc., 1985.

[3] Beale, E.M.L. and Tomlin, J.A., Special Facilities in a General Mathematical Programming System for Non-Convex Problems Using Special Sets of Variables. In "Proceedings 5th IFORS Conference", Wiley, New York, 1969.

[4] Greenberg, H.J., Lucas, C., and Mitra, G., Computer-Assisted Modelling and Analysis of Linear Programming Problems: Towards a Unified Framework, to be published in the IMA journal.

1. Scientific Work

(a) Revision of CAMPS manual

Most of the user specification of the revised system has been completed. This is now prepared as a document titled: CAMPS manual version 2 [1].

(b) Prototype experimental system

The prototype of the revised system is implemented under IBM PC-DOS using a C-compiler and the CURSES screen handling system.

(c) Quality assurance models

A number of models of our own and from the GAMS [2,3] library have been collected and entered into the database of QA test problems. These will be used for the purpose of testing and validation of CAMPS.

2. Research plans

This has remained nearly the same as outlined in our last report. One further topic, see (d) below, has been identified.

The main topics are repeated here for convenience:

(a) Implementation and development of revised CAMPS, including a support function for programmer's interface.

(b) Integration of reformulation support for integer, fuzzy and nonlinear programs within CAMPS.

(c) Inclusion of detailed model and solution analysis tools in CAMPS.

(d) Validation sub-system. This module will be used to support the problem owner to validate the generated model and its solution.

We note here that due to adverse dollar rate the duration of research has been curtailed. It is therefore unlikely we will be able to investigate all these items within this reduced project duration.

3. Administrative change

None

4. Other Information

A paper describing the enhanced CAMPS modelling system will appear in the NATO ASI proceedings [4]. G Mitra is travelling to St. Louis to attend the TIMS/ORSA meeting. He will make a presentation to the University of Pittsburgh and the Graduate School of Industrial Administration, Carnegie Mellon University on the topic of this current research.

5. Financial annex

See attached.

REFERENCES

[1] Lucas, C., and Mitra, G., Computer Assisted Mathematical Programming (Modelling) System: CAMPS, User Reference Manual: Version 2, Brunel University, 1987.

[2] Bisschop, J., and Meeraus, A., On the Development of a General Algebraic Modelling System in Strategic Planning Environment, Mathematical Programming Study 20, North Holland, 1982.

[3] Kendrick, D., and Meeraus, A., GAMS, An Introduction, Development Research Department, The World Bank, 1985.

[4] Lucas, C., and Mitra, G., CAMPS, to appear in the proceedings NATO ASI on Mathematical Models for Decision Support, 1987, Eds. Greenberg, H.G., Lootsma, F., Mitra, G., et al, to be published by Springer Verlag.