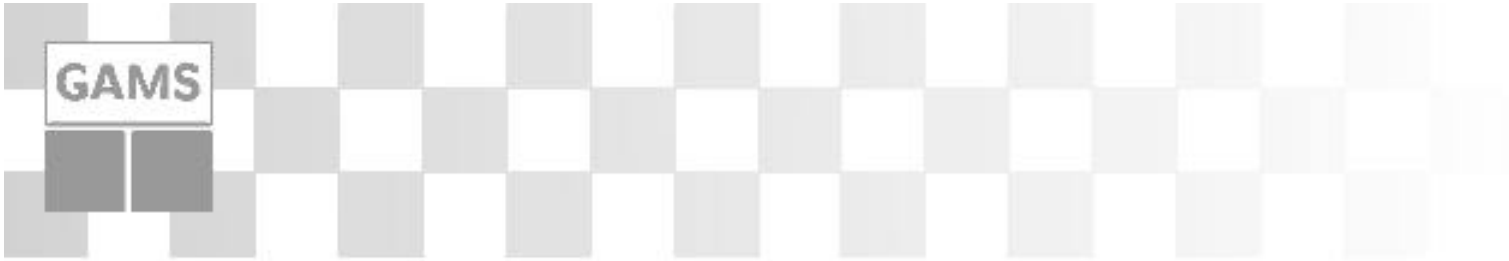

Global Optimization Initiative

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OR2001, Duisburg

Introduction

Background and Motivation

www.gamsworld.org

Global Optimization

Future

View Points

Research Priorities and Incentives

Numeric and Symbolic Software

User Risk

Change in User Focus

Quality Assurance

Dissemination

Market Segmentation

Change in Focus

Computation
Past

- **Algorithm limits** applications
- Problem representation is low priority
- Large costly projects
- Long development times
- Centralized expert groups
- High computational cost, mainframes
- **Users left out**

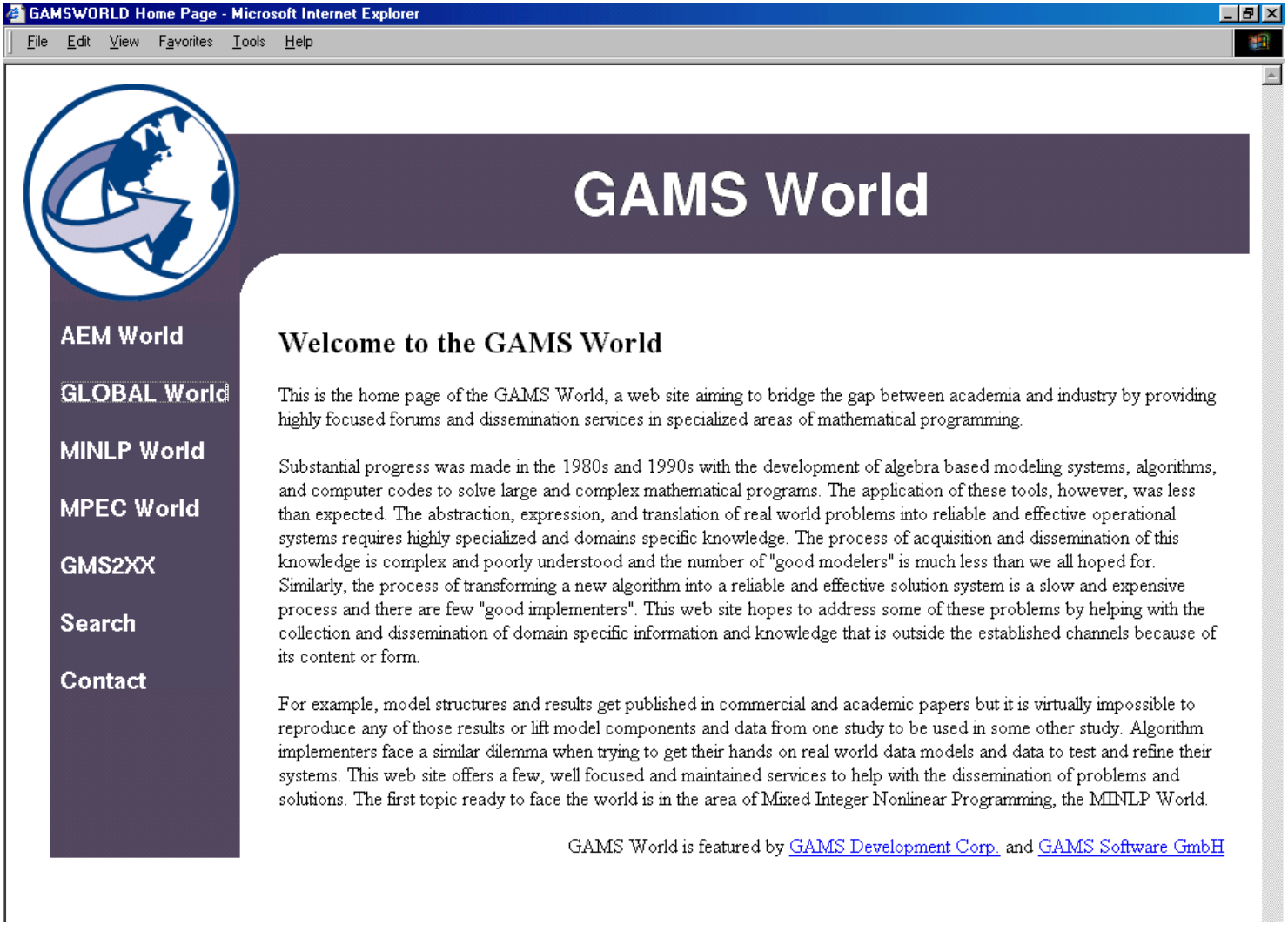
Model
Present

- **Modeling skill limits** applications
- Algebraic model representation
- Smaller projects
- Rapid development
- Decentralized modeling teams
- Low computational cost, workstations
- Machine independence
- **Users involved**

Application
Future

- **Domain expertise limits** application
- Off-the-shelf graphical user interfaces
- Links to other types of models
- Models embedded in business applications
- New computing environments
- Internet/web
- **Users hardly aware of model**

GAMS World Home Page



Purpose of GAMS World

…a web site aiming to bridge the gap between academia and industry by providing highly focused forums and dissemination services in specialized areas of mathematical programming.

Substantial progress in the 1980s and 1990s …. application of these tools less than expected …. abstraction, expression, and translation of real world requires highly specialized and domains specific knowledge … process of acquisition and dissemination of this knowledge is complex and poorly understood…process of transforming a new algorithm into a reliable and effective solution system is a slow and expensive…helping with the collection and dissemination of domain specific information and knowledge that is outside the established channels because of its content or form.

MINLP World Home Page

MINLP World

- Editorial Board
- MINLPLib
- MINLP Solvers
- MINLP List
- Related Links
- Search
- Contact

Welcome to the MINLP World!

MINLP World is a forum for discussion and dissemination of information about all aspects of Mixed Integer Nonlinear Programming (MINLP).

MINLP models are models that combine combinatorial aspects with nonlinearities. MINLP models are much more difficult than both Mixed Integer Linear Programming (MIP) and Nonlinear Programming (NLP) models.

MINLP is still a new field, and we cannot yet solve all the problems that naturally fall within this area. It is the purpose of this site to bring people that work with MINLP together. We are interested in practical software (MINLP Solvers), testing, comparison, and quality of solvers (MINLPLib), research in both solution methods and in good model formulations, and in improving the communication between people interested in these topics (Related Links and MINLP list).

MINLP World is featured by GAMS World

MPEC World Home Page

MPEC World

- Editorial Board
- MPECLib
- MPEC Solvers
- MPEC List
- Related Links
- Search
- Contact

Welcome to the MPEC World!

MPEC World is a forum for discussion and dissemination of information about all aspects of Mathematical Programs with Equilibrium Constraints (MPEC).

MPEC is a relatively new field (not nearly so mature as LP or NLP), and we cannot yet solve many of the problems that naturally fall within this area. It is the purpose of this site to bring people that work with MPEC together. We are interested in practical software (MPEC Solvers), testing, comparison, and quality of solvers (MPECLib), research in both solution methods and in good model formulations, and in improving the communication between people interested in these topics (Related Links and MPEC list).

MINLP World is featured by GAMS World

Global World Home Page

GLOBAL World

- Editorial Board
- GLOBALLib
- GLOBAL Solvers
- GLOBAL List
- Related Links
- Search
- Contact

Welcome to GLOBAL World!

The Global World is a forum for discussion and dissemination of all aspects of computational methods to find global optimal solutions to nonconvex nonlinear optimization problems.

Recently, general purpose global solution algorithms have been implemented and have matured into reliable solution systems that can be connected to modeling systems. These new developments make the application of nonlinear global optimization methods available to users outside the narrow global research community.

General purpose global nonlinear optimization is a new field and much work needs to be done to test the capabilities and robustness on real world models. We are interested in practical software (see GLOBAL Solvers) and an ever growing, well maintained library of academic and practical client test problems in the GLOBAL Library. Communication is supported by maintaining the GLOBAL list server and related links.

For other specialized topics in the are of mathematical programming consult the GAMS World.

GLOBAL World is featured by GAMS World

Editorial Board

GAMS/GLOBAL Solvers

The solvers differ in the methods they use, in whether they find globally optimal solution with proven optimality, and in the size of models they can handle, and in the format of models they accept.

BARON. Branch-and-Reduce algorithm from N. Sahinidis, University of Illinois Urbana-Champaign

LGO. Lipschitz Global Optimization from Pinter Consulting Services, Canada

OQGRG. OptQuest/GRG algorithms by OptTek Systems and Optimal Methods

BARON

BARON is a computational system for solving non convex optimization problems to global optimality. Purely continuous, purely integer, and mixed-integer nonlinear problems can be solved with the software. The Branch And Reduce Optimization Navigator derives its name from its combining interval analysis and duality in its reduce arsenal with enhanced branch and bound concepts as it winds its way through the hills and valleys of complex optimization problems in search of global solutions.

LGO

LGO combines rigorous statistical methods with traditional mathematical programming methods to find solutions within well defined bounds. Tailored versions of LGO have been applied successfully in number of large scale special purpose applications.

OQGRG

OQGRG. This system combines the robust nonlinear optimization technology from Optimal Methods with OptTek's state-of-the-art metaheuristic search procedures, including Tabu Search, Neural Networks, and Scatter Search, into a single composite method.

GLOBALLib

GLOBALLib is a collection of Nonlinear Programming models. The purpose of the collection is to provide algorithm developer of global optimization codes with a large and varied set of both theoretical and practical test models.

- Browse GLOBALLib by model name
- Browse GLOBALLib by author/contributor
- Download GLOBALLib
- Read more about the organization of models and points in GLOBALLib
- GLOBALLib Changelog

Reference

- GLOBALLib Bibliography

Scalar Models

The collection has initially been created by combining small-scale models from the literature with large industrial models. We invite everybody to make contributions to the collection. See the contact page for additional information.

Since many industrial models are based on proprietary information, the models have been translated into a scalar format in which documentation and comments have been removed, sets and set operators have been unrolled, and the original data and structure of the model have disappeared. Most industrial users will accept that translated confidential models can be made publicly available. The scalar models are not intended to serve as guidelines for good modeling practice.

GLOBALLib Model Statistics

Name	Type	#Eqns	#Vars	#NZ	#NNZ	Bestknown	at Point
abel	NLP	15	31	101	30		
alkyl	NLP	8	15	32	19	-1.7650	p1
bearing	NLP	13	14	41	28	1.9517	p1
camcge	NLP	243	280	1356	850		
camcns	NLP	243	280	1356	850		
camshape100	NLP	201	200	697	299		
camshape200	NLP	401	400	1397	599		
camshape400	NLP	801	800	2797	1199		
camshape800	NLP	1601	1600	5597	2399		
catmix100	NLP	201	304	1203	1200		
catmix200	NLP	401	604	2403	2400		
catmix400	NLP	801	1204	4803	4800		
catmix800	NLP	1601	2404	9603	9600		
chain100	NLP	102	203	704	303		
chain200	NLP	202	403	1404	603		
chain400	NLP	402	803	2804	1203		
chain50	NLP	0	0	0	0		
chakra	NLP	42	63	143	41		
chance	NLP	4	5	17	4	29.8944	p1
chem	NLP	5	12	37	11		
chenery	NLP	39	44	133	56		
circle	NLP	10	3	30	30	4.5742	p1

Model Credits

Tendulkar, S	Tesi, A	Tjoa, I B	Tronconi, E	Tuy, H
Vanderbei, R	Varbrand, P	Vicino, A	Visweswaran, V	von Stryk, O
Wall, T W	Westerberg, A W	Weyant, J P	Wilkinson, J H	Williams, A C
Wingo, D	Wollenberg, B F	Wood, A J	Woolsey, R E D	Wright, M H
Xue, G L	Yezza, A	Zenios, S A	Zhou, S	

Credit List:

Abate, M:

- Abate, M, Barmish, B R, Murillo-Sanchez, C, and Tempo, R, Application of Some New Tools to Robust Stability Analysis of Spark Ignition Engines : A Case Study. IEEE Trans. Contr. Syst. Tech. 2 (1994), 22.
- Model:
  - ex7_3_6

Ackermann, J:

- Ackermann, J, Kaesbauer, D, and Muench, R, Robust Gama-Stability Analysis in a Plant Parameter Space. Automatica 27 (1991), 75.
- Models:
  - ex7_3_3
  - ex7_3_5

Client Models

- waterz

GAMS Software Client Models:

- GAMS Development, GAMS Software Client Models.
- Models:
  - 4stufen
  - beuster
  - deb10
  - deb6
  - deb7
  - deb8
  - deb9
  - detf1
  - johnall
  - saa_2
  - var_con10

Sample ‘scalar’ model (1)

alkyl.gms:

Reference:

- Berna, T, Locke, M, and Westerberg, A W, A New Approach to Optimization of Chemical Processes. American Institute of Chemical Engineers Journal 26, 1 (1980), 37-43.
- Original source: GAMS Model of alkyl.gms from GAMS Model Library

Point: p1
Best known point: p1 with value -1.7650

```
*  NLP written by GAMS Convert at 07/26/01 10:00:56
*
*  Equation counts
*     Total       E       G       L       N       X
*         8       8       0       0       0       0
*
*  Variable counts
*                 x       b       i     s1s     s2s      sc      si
*     Total     cont  binary integer    sos1    sos2   scont    sint
*        15       15       0       0       0       0       0       0
*  FX     0        0       0       0       0       0       0       0
*
*  Nonzero counts
*     Total   const      NL     DLL
*        32      13      19       0
*
```

Sample ‘scalar’ model (2)

```
e2..  - 0.8196721311147541*x2 + x5 - 0.8196721311147541*x6 =E= 0;

e3.. 0.98*x4 - x7*(0.01*x5*x10 + x4) =E= 0;

e4..  - x2*x9 + 10*x3 + x6 =E= 0;

e5.. x5*x12 - x2*(1.12 + 0.13167*x9 - 0.0067*x9*x9) =E= 0;

e6.. x8*x13 - 0.01*(1.098*x9 - 0.038*x9*x9) - 0.325*x7 =E= 0.57425;

e7.. x10*x14 + 22.2*x11 =E= 35.82;

e8.. x11*x15 - 3*x8 =E= -1.33;

* set non default bounds

x2.up = 2;
x3.up = 1.6;
x4.up = 1.2;
x5.up = 5;
x6.up = 2;
x7.lo = 0.85; x7.up = 0.93;
x8.lo = 0.9; x8.up = 0.95;
x9.lo = 3; x9.up = 12;
x10.lo = 1.2; x10.up = 4;
```

Sample ‘scalar’ model (3)

```
x3.l = 1.2;
x4.l = 1.1;
x5.l = 3.048;
x6.l = 1.974;
x7.l = 0.893;
x8.l = 0.928;
x9.l = 8;
x10.l = 3.6;
x12.l = 1;
x13.l = 1;
x14.l = 1;
x15.l = 1;

* set non default marginals


Model m / all /;

m.limrow=0; m.limcol=0;

$if NOT '%gams.u1%' == '' $include '%gams.u1%'

Solve m using NLP minimizing objvar;
```

Point Information

Point p1 for model bearing.gms (Best known point)

```
Solution found by BARON
Solution value: 1.95173322000
```

Point: p1

```
$ontext
Solution found by BARON
Solution value: 1.95173322000
$offtext
 e1.m =    0.100000000000E-03;
 e2.m =    0.100000000000E-03;
 e3.m =    0.678797965783E-01;
 e4.m =   -0.100471493287E-04;
 e5.m =    -66740.1820898    ;
 e6.m =   -0.192279198322E-03;
$offlisting
 e7.m =     2.28831817941    ;
 e8.m =   -0.228657564414E-01;
```

Translation Service

In order to use the GMS2XX translation service you have to attach your model to an email to our translation server at gms2xx@gamsworld.org. You specify the language in the subject line, for example

```
Subject: GAMS
```

At the moment we support the following *languages*:

- AMPL
- BARON
- CplexLP
- CplexMPS
- GAMS
- LGO
- LINGO
- MINOPT
- ALL (this creates scalar versions of all supported languages, listed above)

The attached model has to follow some conventions:

- The extension of the attached model is .gms
- The model is self contained, i.e. no $include or $batinclude
- No execution of external programs is allowed, i.e. no $call or execute
- No file creation, i.e. no put files or $echo

LGO Example

```
C
C  Nonzero counts
C      Total    const       NL      DLL
C         19       19        0        0
C
C  **** 8 bounds have been reset in file lgo.in


      Subroutine USER_FCT(x,obj,objname,ctype,g,gname)

      implicit real*8 (a-h,o-z)
      DLL_EXPORT USER_FCT

      dimension x(7),ctype(6),g(6),gname(6)
      character*20 gname,objname
      integer*2 ctype

      objname=' '
      do i=1,6
      gname(i)=' '
      end do

      g(1) =  - 0.225*x(1) - 0.153*x(2) - 0.162*x(3) - 0.225*x(4)
     . - 0.162*x(5) - 0.126*x(6) + x(7)
      ctype(1) = 0

      g(2) =    x(1) + x(2) + x(3) - 350
      ctype(2) = -1

      g(3) =    x(4) + x(5) + x(6) - 600
      ctype(3) = -1
```

Lingo Example

```
!          7        7        0        0        0        0        0        0
!  FX      0        0        0        0        0        0        0        0
!
!  Nonzero counts
!     Total    const       NL      DLL
!        19       19        0        0
!
;

MODEL:

[Obj] MIN = x7;

[e1]   - 0.225*x1 - 0.153*x2 - 0.162*x3 - 0.225*x4 - 0.162*x5 - 0.126*x6 + x7
       = 0;

[e2]     x1 + x2 + x3 <= 350;

[e3]     X4 + x5 + x6 <= 600;

[e4]     x1 + x4 >= 325;

[e5]     x2 + x5 >= 300;

[e6]     x3 + x6 >= 275;

@Free(x7);

End

Init:

End
```

Mailing List

We set up a mailling list for exchanging all sorts of materials, problems, and questions concerning GLOBAL optimization problems.

To **subscribe** to the list send a message to global-l-request@gamsworld.org containing the word *subscribe* only in the subject line.

To **post** to the list after you subscribed send your mail to global-l@gamsworld.org.

You can **unsubscribe** anytime in a similar way: send a message to global-l-request@gamsworld.org containing the word *unsubscribe* only in the subject line.

To obtain more information about your options concerning the list, send a message to the list server account listar@gamsworld.org containing the word *help* only in the subject line.

globallib.gms

The library also contains the GAMS model globallib.gms that helps organizing the models and points in the GLOBALLib. All models are matched with propper references to contributors, publications, and application areas.

The model also help to create batch execution scripts. For example. the following piece of GAMS code creates a batch script that runs models that come from the book "Handbook of Test Problems in Local and Global Optimization" by Floudas e.a. with solver OQGRG :

```
file frs batch run script / rs.bat /;
loop(m$mr(m,"r1"),
  put frs "gams " m.tl:0 " nlp=oqgrg dnlp=oqgrg cns=oqgrg " /;
);
```

Future

Expand GAMSWORLD Coverage

More Source to Source Translations

Preprocessing and Reformulation

Developer Tools

QA Tools