CURRICULUM VITAE

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1 ACADEMIC QUALIFICATIONS

Degree	***Field of study***	***University***	***Year***
B Sc	Mathematics Applied Mathematics Physics	Cape Town	1960
B Sc Hons	Physics	Cape Town	1961
B Sc Hons	Mathematics	Pretoria	1963
M Sc	Physics	South Africa	1964
THED	Teaching	Pretoria	1970
D Sc	Physics	Pretoria	1974
D Eng	Mechanical Engineering	Stellenbosch	2009

2 WORK EXPERIENCE

Employer	***Capacity***	***Period***
National Physical Research Laboratory (CSIR)	Research Officer	01-03-1962 to 30-08-1965
English Electric Leo Computers	Programmer	01-09-1965 to 30-06-1966
I B M (South Africa)	Systems Analyst	01-07-1966 to 30-04-1968
S A Atomic Energy Board	Scientist	01-05-1968 to 31-01-1969
Pretoria Technikon	Lecturer	01-02-1969 to 31-12-1970
University of Pretoria Department of Applied Mathematics	Lecturer Senior Lecturer Associate Professor Full Professor	01-01-1971 to 31-12-1974 01-01-1975 to 31-12-1977 01-01-1978 to 01-01-1982 01-01-1983 to 31-12-1989
Department of Mechanical Engineering	Full Professor Professor Emeritus	01-01-1990 to 30-06-2005 01-07-2005 to present

3 ACADEMIC AND RESEARCH CAREER

3.1 Position in Research Management

Until his retirement in 2005 Snyman headed the research activities of the *Multidisciplinary Design Optimization Group (MDOG)* of the Department of Mechanical and Aeronautical Engineering of the University of Pretoria. In this capacity, during the period 1998 to 2005, he was also the team leader and principal grant-holder of the research programme: *Optimal Design for Industry* that was supported by the South African National Research Foundation (NRF) within the Focus Area: *Economic Growth and International Competitiveness.* As Emeritus Professor in the Department, he continued to make contributions to this NRF programme. (The duration of the funding for this programme was formally been extended by the NRF to cover the period 2006 to 2010, with Prof Albert Groenwold - currently with the University of Stellenbosch - the new principal grant-holder and Snyman a co-investigator.)

Snyman was also the University of Pretoria project-coordinator of the research project: *Optimum design of engineering structures* which was done in collaboration with the University of Miskolc in Hungary (project-coordinator Prof Karoly Jarmai) within the Hungarian-South African Intergovernmental S & T Cooperation Programme. The project was initiated in 2000 and ran until the end of 2006.

3.2 Teaching Experience

Snyman has more than 40 years experience in the teaching of *physics, mathematics* and *engineering mechanics* to science and engineering students, at undergraduate and postgraduate level.

During the *twenty year period 1990 to 2010* the following *semester courses* were regularly presented by him on an annual basis; at undergraduate level: *engineering dynamics,* and at postgraduate level: *advanced dynamics, mathematical optimization* and *numerical methods.*

Snyman has supervised or co-supervised **26** Masters and **8** PhD students (see list of students in Section 5). Two Masters students, for whom Snyman was the sole supervisor, were awarded the prestigious *S_2A_3 Bronze Medal of the Southern Africa Association for the Advancement of Science*: L Rolfes (1982) and L J du Plessis (1999).

He acted as external examiner at undergraduate and/or postgraduate level for nine South African universities, namely Fort Hare, Orange Free State, Port Elizabeth, Potchefstroom, UNISA, Stellenbosch, Transkei, Witwatersrand and Zululand.

3.3 Research interests

3.3.1 <u>Areas of specialization</u>

Over the past twenty five years Snyman's research has focused on two inter-related aspects, namely, (a) the *development of new optimization algorithms* and *optimization methodologies* of specific relevance to solving engineering design problems, and (b) the *application* of these and other optimization techniques to e*ngineering design* problems of practical importance to industry.

The specific reasons for the focus on optimization algorithms are that engineering design optimization problems present unique challenges because of the
(i) *computational expense* associated with the evaluation of the so-called objective and constraint functions used to assess a given design (e.g., time consuming finite element analyses or dynamic simulations may be required);
(ii) *presence of noise* in the objective or constraint functions (due to numerical inaccuracies in the analyses or simulations, or experimental error in monitoring the real-time behavior of some physical system);
(iii) *presence of discontinuities* in the objective/constraint functions arising from formulations of the optimization problem in a form convenient for engineers (e.g. absolute value functions, and penalty function formulations of constrained problems);
(iv) *need for global optimization* because of the existence of many local minima;
(v) *existence of so-called 'holes' in the design space*, where the objective function is not defined (e.g., the problem of non-assembly in the optimum dimensional synthesis of mechanisms and manipulators); and
(vi) occurrence of an *extremely large number of design variables*, disqualifying, for example, standard methods using Hessian information.

All the above aspects, presently of great worldwide interest to design engineers, have been addressed in Snyman's research. Central and essential to tackling the above difficulties has been the development of *novel optimization algorithms* and *methodologies* suitable for engineering problems. This required both the construction of new algorithms (specifically the algorithms LFOPC, FDC-SAM, DYNAMIC-Q, ETOPC and GLOBSF developed by Snyman), and the testing of these new methods on appropriate standard test problems, and real-world engineering design problems. Of particular importance, with reference to the latter, has been the recent work on the optimal design of mechanisms and manipulators by Snyman and his two PhD students, Du Plessis and Hay. This required innovative optimization methodologies, including extended interpolation methods, to determine the respective optimum designs (see recent outputs in Section 4).

Also, of novel educational interest, has been the development of a *Toolkit for Design Optimization (TDO)* in conjunction with MDOG colleagues (see journal paper 55. in Section 4). This toolkit consists of a suite of the optimization codes developed by Snyman, and made available in a user-friendly Windows environment with computer graphics. The toolkit addresses a growing need in education, research and industry for the easy application of mathematical optimization techniques.

3.3.2 Users of Snyman's algorithms

The novel optimization algorithms, developed by Snyman and his co-workers, have been widely used by other researchers and engineers in fields ranging from structures and

composites, vehicle and multi-body dynamics, neural networks, chemistry, fluid flow and heat transfer. Apart from being extensively used by colleagues within the University of Pretoria, the algorithms were also locally used by *Columbus Steel, Denel, ISCOR, SASOL, KENTRON* and the Universities of *Stellenbosch, RAU and UNISA.*

Some known recent *international* users of the algorithms are:
(i) Livermore Software Technology Corporation, Livermore, California, U S A. They use LFOPC as a local optimizer in the LSOPT optimization module of their DYNA automotive simulation system, which is employed in production jobs by *DaimlerChrysler* in *Detroit,* and in research by *DaimlerChrysler* in Stuttgart Germany, and by many other international companies.
(ii) The *Automotive Research Center* of the Department of Mechanical Engineering and Applied Mechanics, University of Michigan, Ann Arbor, U S A.
(iii) The Department of Aerospace Engineering, Mechanics and Engineering Science (AEMES), University of Florida, Gainesville, U S A.
(iv) The Department of Mechanical Engineering, University of Illinois, Urbana-Champaigne, U S A.
(v) The Center for Intelligent Machines and Robotics (CIMAR), Department of Mechanical Engineering, University of Florida, Gainesville, U S A.
(vi) The Systems Engineering Group, Department of Mechanical Engineering, Technical University of Eindhoven, Netherlands.
(vii) Faculty of Mechanical Engineering, University of Miskolc, Hungary.
(viii) Department of Structural Mechanics, Budapest University of Technology and Economics, Budapest, Hungary.
(ix) Fluent Inc., an American CFD software consulting services company, in the optimal design of heat sinks for the electronic industry.
(x) Dr Yann Collette of Renault France converted Snyman's suite of optimization programs for international use through Scilab.

3.4 International visiting positions

- Visiting research fellow: *University of Oxford Computing Laboratory*, Oxford, England, (6 month period: 01-01-1977 to 30-06-1977);

- Visiting professor: *Weizman Institute of Science*, Rehovot, Israel, (3½ month period: 01-01-1984 to 15-04-1984);

- Visiting professor: Center for Intelligent Machines and Robotics (CIMAR), Department of Mechanical Engineering, University of Florida, Gainesville, Florida, USA, (6 month period: 15-01-1998 to 15-07-1998). Taught a post-graduate course: Practical Mathematical Optimization for Engineers, in addition to being involved in research collaboration with Prof Joseph Duffy, Director of CIMAR.

- Visiting research professor: Technische Universiteit Eindhoven, Netherlands, (5 week period: 1-05-2003 to 8-06-2003.

3.5 Professional societies and committees (until 2006)

- Member of the South African Institute of Mechanical Engineers;
- Member of the American Mathematical Society;
- Member of the South African Mathematical Society;
- Member of the South African Institute of Physics;
- Member of the "Suid-Afrikaanse Akademie vir Wetenskap en Kuns", (*LAkad*);
- Registered Professional Natural Scientist (*Pr Sci Nat*) with the South African Council for Natural Scientists;
- Member of the International Society of Structural and Multi-disciplinary Optimization (ISSMO): and
- Member of SANUM (see below).

Snyman was a founder member of South African Society for Numerical Mathematics (SANUM) and during the years 1981-1989 he acted as secretary, vice-chairman and chairman of the Society. This society is still active and annually arranges a conference that constitutes an important South-African forum for applied mathematicians to present and discuss their work in computer modeling and numerical methods and analysis.

He was chairman of the Mathematics and Physics Division of the "Suid-Afrikaanse Akademie vir Wetenskap en Kuns", during 1988-89.

During the period 1984-1986 he was a member of the advisory board of the National Research Institute for Mathematical Sciences (NRIMS), of the South African Council for Scientific and Industrial Research (CSIR). More recently (appointed for the period 2006-8) he served on the National Research Foundation (NRF) Assessment Panel for Engineering.

3.6 International and local recognition

(i) Until 2010 Snyman was rated by the South African National Research Foundation (NRF) as a "Researcher who enjoys considerable international recognition as independent researcher by his peers for high quality and impact of his recent research outputs, with some indicating that he is a leading international scholar in the field"(**B1**). According to the ISI Web of Science Snyman had an H-index of 14 (2010).

(ii) Snyman has received the Exceptional Academic Achiever Award twice (for 2001-2003 and for 2004-2006) from the University of Pretoria in recognition of exceptional academic achievement and the associated promotion of the interests of the University.

(iii) He received the award of *"Professor Honoris Causae Facultatis Mechanicae"* on 10th September 2004, from the University of Miskolc, Hungary, in recognition of his efforts in promoting collaborative research between the University of Pretoria and the University of Miskolc.

(iv) Recipient (26 March 2008) of the University of Pretoria Leading Minds (1908-2008) centenary research medal in recognition of "exceptional achievements that have established the UP as an internationally recognized research university".

(v) In 2009 he was awarded the Senior Doctorate (D Eng) in Mechanical Engineering by the University of Stellenbosch for a doctoral submission entitled: *"Optimization algorithms and methodologies for the optimal design of engineering systems"*.

(vi) Since 1997 he has acted as reviewer for the following accredited international journals:

- *International Journal for Numerical Methods in Engineering (1998, 1999,2004);*
- *Journal of Optimization Theory and Applications (1999);*
- *Mechanism and Machine Theory (1998, 2004, 2005(twice), 2006(twice)), 2011and 2013) ;*
- *A I A A Journal (2003);*
- *Structural and Multidisciplinary Optimization (1998, 2001(twice), 2002, 2007, 2008, 2009);*
- *Applied Mathematical Modelling (1997, 2001)*
- *Global Optimization (2000)*
- *Questiones Mathematica (2001)*
- *Journal of Sound and Vibration (2002, 2003).*
- *IEEE Transactions on Robotics and Automation (2004)*
- *SIAM Review (2005)*
- *Nuclear Inst. and Methods in Physics Research (2006)*
- *Journal of Artificial Evolution and Applications (2007)*
- *AIAA Journal (2008)*

In the past he has also reviewed articles for the following additional journals:

- *Journal of Computational and Applied Mathematics;*
- *Mathematical Programming;*
- *Automatica;*
- *OriON: Journal of the Operations Research Society of South Africa;*
- *The R & D Journal of the South African Institute of Mechanical Engineers;*
- *Die Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie;*

In addition to the above he has refereed numerous papers submitted for publication in various international conference proceedings.

(vi) In 1993 and 1995 Snyman was co-recipient of the *Rand Coal* award of the *South African Institute of Mechanical Engineering* for papers (see 27. and 31. in section 4.1) that appeared in the Institute's R&D Journal.

(vii) He was the recipient of two awards within the *Mellon Foundation Postgraduate Mentoring Programme* (2000-2002: mentor/student-pair Snyman / Du Plessis, and 2001-2003: Snyman / Hay).

3.7 Invited seminar lectures at overseas universities

During overseas visits, on sabbatical or to attend international conferences, *additional invited talks* were given on various aspects of the research outputs listed in Section 4 below, at the following universities.

- Oxford Computing Laboratory, University of Oxford, England (1977).
- Department of Applied Mathematics, Weizman Institute, Israel (1983).
- Department of Mathematics, University of Beersheva, Israel (1983).
- Faculty of Industrial and Management Engineering, Technion, Haifa, Israel (1983).
- School of Mathematical Sciences, University of Tel Aviv, Israel (1983).
- Department of Computer Science, University of Waterloo, Canada (1985).
- Academia Sinica, Taipei, Taiwan (1987).
- National Tsinhua University, Tsinhua,Taiwan (1987).
- National Chiaotung University, Tsinhua, Taiwan (1987).
- National Chingkung University, Tainan, Taiwan (1987).
- Department of Mathematics, Worcester Polytechnic Institute, Massachusetts, USA (1989).
- Department of Mathematics, University of New Orleans, USA (1989).
- Department of Mathematics, Laurentian University, Sudbury, Canada (1989).
- Institüt für Baustatik, University of Stuttgart, Germany (1991).
- Faculty of Technical Mathematics and Informatics, Technical University of Delft, The Netherlands (1994 & 2001).
- Department of Chemical Engineering, University of Princeton, USA (1994).
- Department of Aerospace Engineering, MIT**,** Boston, USA (1994).
- Department of Mathematics, University of Strathclyde, Glasgow, Scotland (1994, 1996, 2001).
- Research Center for Multidisciplinary Analyses and Applied Structural Optimization (FOMAAS), University of Siegen, Germany (1995).
- Department of Mechanical Engineering, University of Illinois, Urbana-Champaigne, USA (1997).
- Department of Mechanical Engineering, University of Florida, Gainesville, USA (1997 & 1998).
- Automation and Robotics Research Institute, University of Texas at Arlington, USA (1998).
- Department of Mechanical Engineering and Applied Mechanics, University of Michigan, Ann Arbor, USA (1999).
- Department of Mechanical Engineering, New Jersey Institute of Technology, Newark, USA (1999).
- Faculty of Mechanical Engineering, University of Miskolc, Hungary (2000, 2001, 2003).
- Faculty of Mechanical Engineering, Technical University of Eindhoven (2001 & 2003).
- Department of Mechanical Engineering, University of Nottingham (2002).

4 RESEARCH OUTPUTS

4.1 Book

Jan A. Snyman: PRACTICAL MATHEMATICAL OPTIMIZATION – *An introduction to basic optimization theory and classical and new gradient-based algorithms*, **Springer**, Cambridge, Massachusetts, February 2005, (ISBN 0-387-24348-8), 257 pages, Hardcover.

4.2 Publications in peer-reviewed journals (J)

(**ISI** journal publications indicated by an *)

1. *Herbstein F H & Snyman J A: Identification of Eckstrom-Adcock iron carbide as Fe_7C_3. *Inorganic Chemistry*, Vol 3 (1964) 894-896.

2. *Herbstein F H & Snyman J A: The crystal structures at 110 and 300 K of the equimolar compound of pyrene and pyromellitic dianhydride. *Phil Trans Roy Soc (London)*, Vol 264 (1969) 635-666.

3. Snyman J A: The measurement of dynamic nuclear reactor parameters of Pelinduna-Zero using the Feynman method. *Tyds Nat Wet*, Vol 10 (1970) 99-113.

4. *Snyman J A & van der Merwe J H: Computed epitaxial monolayer structures I. One-dimensional modal: comparison of computed and analytical results. *Surface Science*, Vol 42 (1974) 190-204.

5. *Snyman J A & van der Merwe J H: Computed epitaxial monolayer structures II. Two-dimensional model: equilibrium monolayer structures in the case of rectangular interfacial symmetry. *Surface Science*, Vol 45 (1974) 619-639.

6. *Snyman J A & Auret F D: Numerical study of linear and nonlinear string vibrations by means of physical discretization. *Appl Math Modelling*, Vol 2 (1978) 7-17.

7. *Snyman J A: Continuous and discontinuous numerical solutions to the Troesch problem. *J Comp and Appl Math*, Vol 5 (1979) 171-175.

8. *Snyman J A & Vermeulen P J: Numerical determination of the configurations of heavy rotating chains. *Appl Math Modelling*, Vol 3 (1979) 232-235.

9. *Sharpe M R & Snyman J A: A model for the emplacement of the eastern compartment of the Bushveld complex. *Tectonophysics*, Vol 65 (1980) 85-110.

10. *Snyman J A & Snyman H C: Computed epitaxial monolayer structures III. Two-dimensional model: zero average strain monolayer structures in the case of

hexagonal interfacial symmetry. *Surface Science,* Vol 105 (1981) 357-376.

11. *Snyman J A: A new and dynamic method for unconstrained minimization. *Appl Math Modelling,* Vol 6 (1982) 449-462.

12. Vermeulen P J & Snyman J A: Numerical determination of the configuration of a rotating blade with constant stress. *Wind Engineering,* Vol 6 (1982) 178-184.

13. *Snyman J A: An improved version of the original leap-frog dynamic method for unconstrained minimization LFOP1(b). *Appl Math Modelling,* Vol 7 (1983) 216-218.

14. Van Niekerk F D & Snyman J A: A global-local finite element method in space-time for a hyperbolic problem. *Quaestiones Mathematicae,* Vol 5 (1983) 379-393.

15. Snyman J A: Unconstrained minimization by combining the dynamic and conjugate gradient methods. *Quaestiones Mathematicae,* Vol 8 (1985) 33-42.

16. Grobler H & Snyman J A: The computation of flow in a rotating annulus by the method of artificial compressibility (in Afrikaans). *South African Journal for Science and Technology,* Vol 6 (1987) 27-35.

17. *Snyman J A & Fatti L P: A multi-start global minimization algorithm with dynamic search trajectories. *Journal of Optimization Theory and Applications,* Vol 54 (1987) 121-141.

18. Snyman J A & Van Rooyen M: An experimental investigation of a new multiplex method for linear programming (in Afrikaans). *South African Journal for Science and Technology,* Vol 6 (1987) 82-88.

19. *Stoop P M & Snyman J A: Computed Fourier series representations of the interaction potential of an argon atom on an argon crystal surface. *Thin Solid Films,* Vol 158 (1988) 151-166.

20. *Snyman J A: A parameter-free multiplier method for constrained minimization problems. *J Comp and Appl Math,* Vol 23 (1988) 155-168.

21. *Snyman J A & Van Rooyen M: A conjugate direction gradient method with reconnaissance steps for unconstrained minimization. *Computers Math Applic,* Vol 16 (1988) 737-745.

22. *Snyman J A: A convergent dynamic method for large unconstrained minimization problems. *Computers Math Applic,* Vol 17 (1989) 1369-1377.

23. *Snyman J A: An interior feasible direction method with constraint projections for linear programming. *Computers Math Applic,* Vol 20 (1990) 43-54.

24. *Kam T Y & Snyman J A: Optimal design of laminated composite plates using a

global optimization technique. *Composite Structures*, Vol 19 (1991) 351-370.

25. *Frangos C & Snyman J A: The application of parameter optimization techniques for linear optimal control system design. *Automatica*, Vol 28 (1992) 153-157.

26. *Snyman J A, Frangos C & Yavin Y: Penalty function solutions to optimal control problems with general constraints via a dynamic optimization method. *Computers Math Applic*, Vol 23 (1992) 47-56.

27. Snyman J A & Vermeulen P J: The mathematical modelling of the motion of a horizontal vibrating screen supported by ROSTA oscillating mountings. *R & D Journal of the S A I Mech E*, Vol 8, No 3 (1992) 25-33.

28. *Stander N & Snyman J A: A new first order interior feasible direction method for structural optimization. *International Journal for Numerical Methods in Engineering*, Vol 36, No 23 (1993) 4009-4026.

29. Vermeulen P J & Snyman J A: The determination of the force distribution in the carrying cable of a cable way (in Afrikaans). *South African Journal for Science and Technology*, Vol 12, No 3 (1993) 55-60.

30. Vermeulen P J & Snyman J A: A unified feasible direction interior approach to the minimization of linear and general objective functions subject to linear constraints. *ORiOn, Journal of the Operations Research Society of SA*, Vol 8, No 2 (1993) 90-97.

31. Van Wyk A J, Snyman J A & Heyns P S: Optimization of a vibratory conveyor for reduced support reaction forces. *R & D Journal of the S A I Mech E*, Vol 10 (1994) 12-17.

32. *Snyman J A & Stander N: A new successive approximation method for optimum structural design. *AIAA Journal*, Vol 32 (1994) 1310-1315.

33. *Snyman J A, Stander N & Roux W J: A dynamic penalty function method for the solution of structural optimization problems. *Appl Math Modelling*, Vol 18 (1994) 453-460.

34. *De Klerk E & Snyman J A: A feasible descent cone method for linearly constrained minimization problems. *Computers Math Applic*, Vol 28 (1994) 33-44.

35. Stander N, Roux W J & Snyman J A: Conceptual design of rigidly framed structures using optimization methods. *Journal of the South African Institution of Civil Engineers*, Vol 36 (1994) 9-14.

36. *Snyman J A, Heyns P S & Vermeulen P J: Vibration isolation of a mounted engine through optimization. *Mechanism and Machine Theory*, Vol 30 (1995) 109-118.

37. *Stander N, Snyman J A & Coster J E: On the robustness and efficiency of the SAM algorithm for structural optimization. *International Journal for Numerical Methods in Engineering*, Vol 38 (1995) 119-135.

38. Niemand L J, Snyman J A & Wannenburg J: Profile optimization of a cultivator, *R & D Journal of the S A I Mech E*, Vol 11 (1995) 1-5.

39. *Snyman J A & Stander N: Feasible descent cone methods for inequality constrained optimization problems. *International Journal for Numerical Methods in Engineering*, Vol 39 (1996)1341-1356.

40. *Groenwold A A, Snyman J A & Stander N: A modified trajectory method for practical global optimization problems. *AIAA Journal*, Vol 34 (1996) 2126-2131.

41. *Groenwold A A, Stander N & Snyman J A: A pseudo discrete rounding method for structural optimization. *Structural Optimization*, Vol 11 (1996) 218-227.

42. *Snyman J A & Berner D F: A mathematical optimization methodology for the optimal design of a planar robotic manipulator. *International Journal for Numerical Methods in Engineering*, Vol 44 (1999) 535-550.

43. *Berner D F & Snyman J A: The influence of joint angle constraints on the optimum design of of a manipulator following a complicated path. *Computers Math Applic* Vol 37 (1999) 111-124.

44. *Craig K J, de Kock D J & Snyman J A: Using CFD and mathematical optimisation to minimize stack pollution. *International Journal for Numerical Methods in Engineering*, Vol 44 (1999) 551-566.

45. *Groenwold AA, Stander N & Snyman J A: A regional genetic algorithm for discrete optimal design of truss structures. *International Journal for Numerical Methods in Engineering*, Vol 44 (1999) 749-766.

46. *Craig K J, Venter P, de Kock D J & Snyman J A: Optimization of structured grid spacing parameters for separated flow simulation using mathematical optimization. *Journal of Wind Engineering and Industrial Aerodynamics*, Vol 80 (1999) 221-231.

47. *Snyman J A & van Tonder F: Optimum design of a three dimensional robotic manipulator. *Structural Optimization* Vol 17 (1999) 172-185.

48. *Snyman J A & Berner D F: The design of a planar robotic manipulator for optimum performance of prescribed tasks. *Structural Optimization* Vol 18 (1999) 95-106.

49. *De Kock D J, Craig K J & Snyman J A: Using mathematical optimization in the CFD analysis of a continuous quenching process. *International Journal for*

Numerical Methods in Engineering Vol 47 (2000) 985-999.

50. *Snyman J A: The LFOPC leap-frog method for constrained optimization. *Computers Math. Applic*., Vol. 40 (2000) 1085-1096.

51. *Hay A M & Snyman J A: The determination of non-convex workspaces of generally constrained planar Stewart platforms. *Computers Math Applic*, Vol. 40 (2000) 1043-1060.

52. *Snyman J A, Du Plessis L J & J Duffy: An optimization approach to the determination of the boundaries of manipulator workspaces. *The ASME Journal of Mechanical Design*, Vol.122 (2000) 447-456.

53. *Craig K J, De Kock D J & Snyman J A: Minimizing the effect of automotive pollution in urban geometry using mathematical optimization. *Atmospheric Environment*, Vol. 35 (2001) 579-587.

54. *Snyman J A & Hay A M: The spherical quadratic steepest descent method for unconstrained minimization with no explicit line searches. *Computers Math Applic,* Vol 42 (2001) 169-178.

55. Snyman J A, De Kock D J, Craig K J & Venter P J: Toolkit for Design Optimization (TDO): An Educational aid to mathematical modeling and optimization. *Quaestiones Mathematicae,* Suppl.1 (2001) 227-236.

56. *Du Plessis LJ & Snyman J A: A numerical method for the determination of dextrous workspaces of Gough-Stewart platforms. *International Journal for Numerical Methods in Engineering*, Vol 52 (2001) 345-369.

57. *Minnaar R J, Tortorelli DA & Snyman JA: On nonassembly in the optimal dimensional synthesis of planar mechanisms. *Structural and Multidisciplinary Optimization*, Vol 21 (2001) 345-354.

58. *Hay A M & Snyman J A: The chord method for the determination of non-convex workspaces of planar manipulators. *Computers Math Applic*, Vol 43 (2002) 1135-1151.

59. *Snyman J A & Smit W J: The optimal design of a planar parallel platform for prescribed machining tasks. *Multibody System Dynamics*, Vol 8 (2002) 103-115.

60. *Snyman J A & Hay A M: The Dynamic-Q optimization method: an alternative to SQP? *Computers Math. Applic*. Vol 44 (2002) 1589-1598.

61. *Groenwold A A & Snyman J A: Global optimization using dynamic search trajectories. *Journal of Global Optimization*, Vol 24 (2002) 51-60.

62. *Jármai K, Snyman J A. Farkas J & Gondos G: Optimal design of a welded I-section frame using four conceptually different optimization algorithms.

Structural and Multidisciplinary Optimization, Vol 25 (2003) 54-61.

63. *Naude A F & Snyman J A: Optimisation of road vehicle passive suspension systems. Part I: Optimization algorithm and vehicle model. *Applied Mathematical Modelling*, Vol 27 (2003) 249-261.

64. *Naude A F & Snyman J A: Optimisation of road vehicle passive suspension systems. PartII: Qualification and case study. *Applied Mathematical Modelling*, Vol 27 (2003) 263-274.

65. *Du Plessis L J & Snyman J A: Trajectory-planning through interpolation by overlapping cubic arcs and cubic splines. *International Journal for Numerical Methods in Engineering*, Vol 57 (2003) 1615-1641.

66. *Long C S, Snyman J A & Groenwold A A: Optimal structural design of a planar platform for machining. *Applied Mathematical Modelling*, Vol. 27(2003) 581-609.

67. *Hay A M & Snyman J A: Methodologies for the optimal design of parallel manipulators. *International Journal for Numerical Methods in Engineering*, Vol. 59, (2004) 131-152.

68. *Bolton H P J, Groenwold A A & Snyman J A: The application of a unified Bayesian stopping criterion in competing parallel algorithms for global optimization. *Computers Math. Applic*. Vol. 48 (2004) 549-560.

69. *Jármai K. Snyman J A and Farkas J: The application of novel constrained optimization algorithms to the minimum volume design of planar CHS trusses with parallel chords. *Engineering Optimization*, Vol. 36 (2004) 457-471.

70. *Snyman J A: A gradient-only line search method for the conjugate gradient method applied to constrained optimization problems with severe noise in the objective function. *International Journal for Numerical Methods in Engineering*, Vol. 62 (2005) 72-82.

71. *Hay A M & Snyman J A: Optimization of a planar tendon-driven manipulator for a maximal dextrous workspace. *Engineering Optimization*, Vol. 37 (2005) 217-236.

72. *Hay A M & Snyman J A: A multi-level optimization methodology for determining the dextrous workspaces of planar parallel manipulators. *Structural and Multidisciplinary Optimization*, Vol. 30 (2005) 422-427.

73. *Du Plessis L J & Snyman J A: An optimally re-configurable planar Gough-Stewart machining platform. *Mechanism and Machine Theory*, Vol. 41 (2006) 334-357.

74. *Du Plessis L J & Snyman J A: Determination of optimum geometries for a planar re-configurable machining platform using the LFOPC optimization algorithm. *Mechanism and Machine Theory*, Vol.41 (2006) 307-333.

75. *Els P S, Uys P E, Snyman J A & Thoresson M J: Gradient-based approximation methods applied to the optimal design of vehicle suspension systems using computational models with severe inherent noise. *Mathematical and Computer Modelling*, Vol. 43 (2006) 787-801.

76. *Jarmai K, Snyman J A & Farkas J: Minimum cost design of a welded orthogonally stiffened cylindrical shell. *Computers and Structures*, Vol. 84 (2006) 787-797.

77. *Gyulai L, Szilárd Szabó S, De Kock D J, & Snyman J A: Optimal adjustment of the number of air changes of a smelter pot room by using mathematical optimization. *Structural and Multidisciplinary Optimization*, Vol. 32, (2006) 409-421.

78. *Hay A M & Snyman J A: Optimal synthesis for a continuous prescribed dexterity interval of a 3-dof parallel planar manipulator for different prescribed output workspaces. *International Journal for Numerical Methods in Engineering*, Vol. 68 (2006) 1-12.

79. *Pattinson J & Snyman J A: Mathematical modelling and optimal design of a conceptually new catapult. *South African Journal of Science*, Vol. 102 (2006) 557-562.

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4.3.1 International Conferences

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4.3.2 Local Conferences

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5 POSTGRADUATE RESEARCH STUDENTS

Postgraduate students, with completion dates in brackets, supervised / co-supervised by Snyman are listed below.

5.1 Masters students

F D Auret (1976)

J W Hearn (1976)

J van Heerden (1978)

A E M Henning (1980)

L Rolfes (1981)

C Steenkamp (1982)

P Stoop (1986)

H Grobler (1886)

M Rajavedan (1988) (co-supervised with Prof A P Deston)

D A Vermeulen (1988)

E Buitendag (1990) (co-supervised with Prof P J Robbertse)

G R Venter (1990)

E de Klerk (1992) (co-supervised with Prof E M Matthews)

W J Roux (1993) (co-supervised with Prof N Stander)

A G Polson (1994) (co-supervised with Prof N Stander).

A J van Wyk (1994)

G J Loubser (1995)

K A Geerthsen (1996)

D F Berner (1996)

F Tonder (1997)

L J Du Plessis (1998)

R J Minnaar (1999) (co-supervised with Prof. Dan Tortorelli of the University of Illinois)

A M Hay (1999)

W J Smit (2000)

C S Long (2001) (co-supervised with Prof A A Groenwold).

M J Thoresson (2003) (co-supervised with Dr P E Uys)

5.2 PhD Students

A F Meiring (1980)

F D van Niekerk (1981)

A J Lubbe (1983)

J van Heerden (1984)

L J Du Plessis (2001)

A F Naude (2002)

A M Hay (2003)

O S Motsamai (2008) (co-supervised with Prof J P Meyer)

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