

Table of Contents

Preface	XIII
International Scientific Committee	XV
<i>Invited lectures</i>	
State of the industry <i>T.T. Wohlers</i>	1
Rapid manufacturing of metallic objects: A challenge for research and industry <i>A. Bernard & K.P. Karunakaran</i>	7
Data fusion and shape retrieval methods for 3D geometric structures <i>A. Fischer</i>	15
Scan and solve: Acquiring the physics of artifacts <i>M.K. Freytag, V. Shapiro & I. Tsukanov</i>	23
Tangible virtual reality for product design <i>I. Horváth</i>	35
Interoperability isn't (yet), and what's being done about it <i>D. Prawel</i>	47
The use of multiple materials in Rapid Prototyping <i>I. Gibson, M.M. Savalani, A. Tarik & Y. Liu</i>	51
A novel poly (lactic-co-glycolic acid)-collagen hybrid scaffold fabricated via multi-nozzle low-temperature deposition <i>L. Liu, Y. Yan, Z. Xiong, R. Zhang & X. Wang</i>	57
Scaffold-based bone engineering by using Rapid Prototyping Technologies <i>D.W. Hutmacher</i>	63
<i>Biomanufacturing</i>	
Mechanical behaviour and vascularisation analysis of tissue engineering scaffolds <i>H.A. Almeida, P.J. Bártoł & J.C. Ferreira</i>	71
Evolutionary optimization for soft tissue engineering <i>M. Rezende, R. Rezende, A. Mendes, P. Bártoł, A. Costa & R.M. Filho</i>	81
Porogen-based solid freeform fabrication of polycaprolactone-calcium phosphate scaffolds for tissue engineering <i>L. Lu, J. Zhou, M. Mondrinos, P. Lelkes & D. Wootton</i>	87

Development of novel rapid-freeze prototyping for tissue engineering <i>T.C. Lim, C.B. Pham, K.S. Chian & K.F. Leong</i>	97
Evaluation of degradation of bioabsorbable polycaprolactone used in Rapid Prototyping for medical application <i>C.L. Salgado, E.M.S. Sanchez, C.A.C. Zavaglia, M.F. Oliveira & J.V.L. Silva</i>	101
Laser powder micro deposition of Ti6Al4V for the rapid manufacture of dental implants <i>C. Meacock, A. Crespo & R. Vilar</i>	107
Functionally graded scaffolds: The challenges in design and fabrication processes <i>C.K. Chua, N. Sudarmadji & K.F. Leong</i>	115
Characterisation of HA/polymer bio-composite structure fabricated by selective laser sintering <i>L. Hao, M.M. Savalani, Y. Zhang, K.E. Tanner & R.A. Harris</i>	121
Classification of image artifacts due to amalgam restoration in Computed Tomography for the improvement of Rapid Prototyping biomodels <i>T.A.C.P. Martins</i>	129
<i>InVesalius</i> : Three-dimensional medical reconstruction software <i>T.A.C.P. Martins, A. Santa Bárbara, G.B. Silva, T.V. Faria, B. Cassaro & J.V.L. Silva</i>	135
Two-dimensional X-ray simulation based on Computed Tomography images <i>F.F. Souza, T.A.C.P. Martins, T.R.D. Velho, B.C. Dalava & J.V.L. Silva</i>	143
An integrated physical and virtual prototyping approach for medical applications <i>S. Singare, W.P. Wang, J. Wang, Y. Liu, D. Li & B. Lu</i>	149
The virtual biomodel as a complementary resource for the diagnosis of mandibular ankylosis <i>C.H.S. Villela, P.Y. Noritomi, A.M. Silva, J.V.L. Silva, M.G.P. Cavalcanti, A.C. Passini & C.A.C. Zavaglia</i>	155
Customized implant development for maxillo-mandibular reconstruction <i>C. Pereira, F. Ventura, M.C. Gaspar, R. Fontes & A. Mateus</i>	159
Rapid Prototyping applied to surgical planning for correcting craniofacial malformations in wild animals. A case study of a brazilian fox <i>E.P. Freitas, C.R. Teixeira, S.C. Rahal, C.H.S. Villela, J.V.L. Silva, P.Y. Noritomi & S. Yamashita</i>	167
BioExtrusion for tissue engineering applications <i>A.J. Mateus, H.A. Almeida, N.M. Ferreira, N.M. Alves, P.J. Bártoolo, C.M. Mota & J.P. de Sousa</i>	171
<i>CAD and 3D data acquisition technologies</i>	
Automatic usability data acquisition and interface simulation using stereolithography mock-up and internal video analysis <i>T. Murakami</i>	177
Heterogeneous soft material modeling and virtual prototyping with 5-DOF haptic force feedback for product development <i>S. Lin, Y.-S. Lee & R. Narayan</i>	187
Reverse engineering from 3D optical acquisition: Application to crime scene investigation <i>G. Cavagnini, M. Scalvenzi, M. Trebeschi & G. Sansoni</i>	195

A novel high-resolution algorithm for detecting laser stripe center <i>Z. Li, C. Wang, Y. Shi & G. Zhou</i>	203
Fast digitizing of 3D shapes by automatic alignment of multiple range maps <i>S. Barone, A. Paoli & A.V. Razonale</i>	209
Coded targets photogrammetry for 3D digitization of human faces <i>L.M. Galantucci, G. Percoco & U. Dal Maso</i>	217
Surface roughness parameters determination model in machining with the use of design and visualization technologies <i>N. Bilalis, M. Petousis & A. Antoniadis</i>	223
Preliminary budget methodology for reverse engineering applications using laser scanning <i>T. Albarran, L. Lopes, J. Cabeça, R.F. Martins & A.J.F. Mourão</i>	231
A Neural Network technique for re-meshing of bone micro-structure <i>Y. Holdstein, L. Podshivalov, A. Fischer & P.Z. Bar-Yoseph</i>	237
Knowledge representation for subassembly designing using CBR methodology <i>G.I. Nekrassov & L.A. Portjanski</i>	243
Theses analysis on CAD/RP technology <i>R.T. Pupo</i>	251
Agile-CAD for reverse engineering <i>R. Ferreira, I. Leal, N. Alves & P. Bárto</i>	257
Materials	
Electrowetting based multi-microfluidics array printing of high resolution tissue construct with embedded cells and growth factors <i>J. Zhou, L. Lu, K. Byrapogu, D. Wootton, P. Lelkes & R. Fair</i>	263
Fabrication of functionally graded bio materials by Nano Composite Deposition System <i>H.-J. Kim, W.-S. Chu, S.-H. Ahn & C.S. Lee</i>	275
Biodegradable stereolithography resins with defined mechanical properties <i>J. Stampfl, M. Schuster, S. Baudis, H. Lichtenegger, R. Liska, C. Turecek & F. Varga</i>	283
The influence of bond-coating on plasma sprayed alumina-titania, doped with biologically derived hydroxyapatite, on stainless steel <i>S. Salman, B. Cal, O. Gunduz, S. Agathopoulos & F.N. Oktar</i>	289
Acrylic based hydrogel phantom for in-vitro ultrasound contrast agent characterization <i>C. Demitri, F. Montagna, A. Sannino & A. Maffezzoli</i>	295
A study of the degradation of Duraform PA due to cyclic processing <i>N.T. Sewell, M. Felstead, M.R. Sloan & M.A. Jenkins</i>	299
The manufacturing of PMMA/PS blends by selective laser sintering <i>G.V. Salmoria, J.L. Leite, C.N. Lopes, R.A.F. Machado & A. Lago</i>	305
Manufacture by selective laser sintering of functionally graded PA6/PA12 components with applications in antifriction materials <i>G.V. Salmoria, J.L. Leite, C.H. Ahrens, R.A. Paggi & A. Lago</i>	313

Investigation of shrinkage strains in a photo-curable resin for 3D micro-fabrication
using a FBG sensor
C. Schizas & D. Karalekas

319

Development of nanocomposite material for rapid manufacturing: Application in
microreactor technology
*A.L. Jardini, M.C.B. Costa, R.A. Rezende, S.R. Andrade,
M.A. Scarparo & R. Maciel Filho*

325

Manufacturing cellular materials via Three-Dimensional Printing of spray-dried
metal oxide ceramic powder
C.B. Williams & D.W. Rosen

331

Material characterization for Fused Deposition of Ceramics
F.M. Barreiros, D. Santos & P.J. Bárto

341

Localized irradiations for covalent graftings on glass substrates
F. Evenou, S. Corbel, F. Baros & M.C. Carré

347

Rapid prototyping of amorphous silica through laser stereolithography
M. Fersini, F. Montagna, A. Licciulli & A. Maffezzoli

353

Development of a model to optimize the sand shape and post process parameters for parts produced
by Direct Croning Process
A. Gatto, L. Iuliano & F. Cannella

359

Additive manufacturing of Ti-6Al-4V based components with high power fiber lasers
G. Lopes, S. Williams, R.M. Miranda, L. Quintino & J.P. Rodrigues

369

Copper powder densification by means of DMLF process: The effect of energy
density input and oxidation
J. Sanz-Guerrero & J. Ramos-Grez

375

Foaming alginate for tissue engineering
P.J. Bárto, A. Mendes, R.A. Rezende & R.M. Filho

383

The effect of thermal conductivity of RIM moulds in kinetics cure
A. Mateus, P.J. Bárto, G. Mitchell, M. Silva, A.S. Pouzada & A.J. Pontes

389

Composition and cure temperature: The influence on properties of final flexible
PU cold cure foam parts
A. Cerva, C. Capela, A. Mateus, P.J. Bárto & G. Mitchell

395

Rapid tooling and manufacturing

Digitally Adjustable Tooling technology for dieless forming and jigless assembly of panels
D.T. Pham, S.Z. Su, M.Z. Li, C.G. Liu & F. Massabé

401

Rapid Tooling and the LOMOLD process
D. Dimitrov, E.F. Joubert & N. de Beer

409

Fabrication of stainless steel and ceramic parts with the Optoform process
A.-M. Clarinval, R. Carrus, T. Dormal & Q. Soyeur

415

Manufacturing criteria in hybrid modular tools: How to combine additive and subtractive processes
O. Kerbrat, P. Mognol & J.Y. Hascoet

419

The effect of the mould material selection and production methodology on the thermal behaviour and tribology of injection moulds <i>L. Cardon, R. Houtekier, K. Ragaert & M. Moerman</i>	425
CAD/CAE techniques to prevent premature failure in direct AIM moulding inserts <i>D.A. Guimarães & A.J. Pontes</i>	431
Rapid Tooling aided by Virtual Prototyping for blow-molds development <i>J.C. Ferreira & G.S. Franco</i>	437
Multiple material moulds – Directives for blow moulding design <i>R. Houtekier, M. Moerman, S. Verstraeten, L. Cardon, A. Voet, B. Van Pee & J. Migneau</i>	443
Rapid Prototyping applied to a new development in moulds for rotational moulding <i>M. Monzón, M.D. Marrero, A.N. Benítez, P.M. Hernández & M. Kearns</i>	449
Rapid Tooling route selection and evaluation for sand and investment casting <i>D.K. Pal, T.K. Raychaudhuri, B. Ravi & K. Subburaj</i>	455
Direct manufacturing of pneumatic grippers by stereolithography <i>U. Berger</i>	463
Rapid Metal Casting – A review of present status <i>J.C. Ferreira, P.J. Bártolo, N.F. Alves & A.S. Mateus</i>	469
Pursuing successful Rapid Manufacturing in a standards-less industry: A best practice approach <i>J. Munguía</i>	477
Application of Rapid Prototyping/Rapid Tooling in manufacturing experimental stereotypes of new-style emitters <i>L. Gang, S. Yusheng, W. Qingsong, D. Wenchum & L. Jie</i>	483
<i>Advanced rapid prototyping technologies and nanofabrication</i>	
Laser Micro Sintering – A new method to generate metal and ceramic parts of high resolution with sub-micrometer powder <i>H. Exner, M. Horn, A. Streek, P. Regenfuß, F. Ullmann & R. Ebert</i>	489
Process accuracy during laser based stereo lithography and production of Ormocer® micro systems with related mechanical properties <i>A. Neumeister, C. Materlik, T. Temme, A. Ostendorf & R. Himmelhuber</i>	501
Freeform fabrication of metals by 3D Micro Welding <i>T. Horii, Y. Yamamoto, S. Kirihara, Y. Miyamoto & N. Yamanaka</i>	509
Deep Proton Writing: A tool for rapid prototyping of polymer micro-opto-mechanical modules <i>C. Debaes, J. Van Erps, M. Vervaeke, L. Desmet, H. Ottevaere, V. Gomez, S. Van Overmeire, P. Vynck, A. Hermanne & H. Thienpont</i>	515
Feedback control of Selective Laser Melting <i>J.-P. Kruth, P. Mercelis, J. Van Vaerenbergh & T. Craeghs</i>	521
Selective Laser Melting of lattice structures in solid shells <i>O. Rehme, C. Emmelmann & D. Schwarze</i>	529
Complex structure micro-parts formed with Selective Laser Melting method <i>Z. Wenxian, S. Yusheng, L. Jinhui, L. Zhongliang & H. Shuhuai</i>	537

Type HRPM-II machine for Selective Laser Melting process <i>Z. Wenxian, S. Yusheng, L. Jinhui, L. Zhongliang, C. Guoqing & H. Shuhuai</i>	541
Investigation on polyamide powder properties deterioration and efficient powder recycling in Laser Sintering <i>K.D. Dotchev, D.T. Pham, W.A.Y. Yusoff & S. Soe</i>	545
Influence of the process parameters on the liquid bridges between particles in SLS <i>J. Jhabvala, E. Boillat, R. Glardon & M. Dafflon</i>	553
Application of rapid manufacturing to build artifacts for using in microgravity environment. An International Space Station case <i>I.A. Maia, M.F. Oliveira, P.Y. Noritomi & J.V.L. Silva</i>	559
Intelligent optimization of process parameters in selective laser sintering <i>Y.S. Shi, Z.L. Lu, J.H. Liu, C.Y. Pan & S.H. Huang</i>	563
Expanding applications and opportunities with polyjet™ Rapid Prototyping technology <i>O. Sagi & A. Libermann</i>	569
A novel combination of materials for rapid manufacturing of 3-dimensional objects by ink-jet printing <i>T. Wang, B. Derby, R.C. Patel & L. Messe</i>	575
Super-saturation drowning-out coating of metal particles for usage in layered manufacturing processes; Process development, design and manufacturing of coating machine <i>S. Saedodin, A. Mirahmadi & Y. Shanjani</i>	581
SEDS – A new rapid prototyping method based on metal powder sintering <i>S. Saedodin, A. Mirahmadi & Y. Shanjani</i>	589
Laminated Object Manufacturing with aluminium bonded sheets <i>A.M. Pereira, P.J. Bárto, J.M. Ferreira & F. Antunes</i>	597
Ultrasonic Consolidation with aluminum and copper <i>G.D. Janaki Ram, D.H. Johnson & B.E. Stucker</i>	603
Incremental Sheet Forming (ISF) as small batch production method <i>J. Tuomi & L. Vihtonen</i>	611
Some experimental studies of mechanical behavior of FDM Rapid Prototyped parts <i>A.E. Lam, A.V. Borille & J.O. Gomes</i>	617
Part strength analysis of Shell Assisted Layer Manufacturing (SALM) <i>A.K. Egodawatta, D.K. Harrison, A.K.M. De Silva, G. Haritos & P. Keenan</i>	623
Effect of constraint on residual stresses and deformations in weld based Rapid Prototyping <i>H. Fawad, M.P. Mughal & R.A. Mufti</i>	629
Investigations of the energy input of different metal processing, additive layer manufacturing methods <i>M.F. Zäh, S. Lutzmann & G. Branner</i>	635
A new 2D inner/outer contour identification method for layer manufacturing <i>N. Volpato, J.S.O. Baba & T. Manczak</i>	641

Putting it all together: Rapid Prototype as Design <i>O. Diegel, T. Neitzert, D. Singh, S. Singamneni, J. Potgieter, W.L. Xu & G. Bright</i>	647
Multi-objective optimal positioning and packing for layered manufacturing <i>J.A. Leitão, R. Everson, N. Sewell & M. Jenkins</i>	655
Lean thinking and Rapid Prototyping: Towards a shorter distance between the drawing board and the construction site <i>G. Celani, A.D. Granja & E. Pinheiro</i>	661
Novel Rapid Prototyping processes - building movable parts <i>F. Ansorge, K. Badstübner & H. Reichl</i>	665
Functionally Gradient Material laser rapid prototyping system <i>S. Xiaofeng, W. Zhijian & W. Wei</i>	667
<i>Virtual environments</i>	
3D Photo-realistic talking head for human-robot interaction <i>C. Simplicio, D.R. Faria & J. Dias</i>	675
Human machine interaction based on Bayesian analysis of human movements <i>J. Rett & J. Dias</i>	683
Collaborative workspace for aircraft maintenance <i>G. Gautier, T. Fernando, C. Piddington, E. Hinrichs, H. Buchholz, P-H. Cros, S. Milhac & D. Vincent</i>	689
Generation of an automobile driving training interactive environment <i>J.S. Liang</i>	695
Functional requirements for user-interface architectures for Virtual Enterprise dynamic reconfiguration <i>P. Gonçalves, M. Cunha & G.D. Putnik</i>	703
The feasibility of consumer evaluation of products using virtual prototyping technologies <i>R.A. Barge, R.I. Campbell & K.S. Badni</i>	709
Digital fabrication in the arts: Just another technical reproduction advance leap or a new artistic revolution? <i>G. Celani</i>	717
Modeling of heat transfer and phase transformations in the rapid manufacturing of dental prosthesis by laser powder micro-deposition <i>A. Crespo, A.M. Deus & R. Vilar</i>	723
<i>Collaborative design and engineering</i>	
3D scan and RP for the as-built data collection and related design studies in a city <i>N.J. Shih</i>	729
Augmented Prototyping as a design means for industrial design - a multiple case analysis <i>J. Verlinden & I. Horváth</i>	739
Method for increasing innovation capacity in development of casing type details <i>B. Matsi, M. Sarkans, T. Otto & L. Roosimölder</i>	747

The impact of the Rapid Prototyping in the product design development <i>J.R.L. Santos</i>	753
A new conceptual framework based on the ECSI model to support Axiomatic Design <i>I. Ferreira, J. Sarsfield Cabral & P. Saraiva</i>	757
Efficiency analysis of prototype evolution methodology on collaborative design <i>X.B. Chen & S.S. Huang</i>	763
Whither one of a kind? <i>P. Carrizzi & R. Strzelec</i>	771
Custom design, more than custom to fit! <i>S. Killi</i>	777
<i>Applications</i>	
Saving a project through Rapid Manufacture in South Africa <i>L.J. Barnard & D.J. de Beer</i>	785
Mass customisation of foot orthoses for rheumatoid arthritis <i>J. Pallari, K.W. Dalgarno & J. Woodburn</i>	795
Tactile scale models: Three-dimensional info-graphics for space orientation of the blind and visually impaired <i>G. Celani & L.F. Milan</i>	801
Using intelligent prototypes to improve the aerodynamic design of race car aerofoil profiles <i>U. Klaeger & A. Hoffmann</i>	807
Effect of wind loading on low rise buildings using finite element modelling and Computational Fluid Dynamics: A Commercially Focused Approach <i>S.M. Taylor, A.E.W. Rennie & W. McDonald</i>	811
Rapid product development by reverse engineering <i>M. Jurković, M. Mahmić & M. Brezočnik</i>	817
Study of a composite material with metallic particles for application in an automobile component <i>J. Bolrão, C. Capela, F. Antunes & P. Camão</i>	823
Development of a type of sandwich panels for the aeronautical industry <i>C. Gomes, C. Capela & P. Camano</i>	829
Study and characterization of a material with carbon fibres for the production of an ergonomic easy chair <i>A. Cerca, C. Gomes & C. Capela</i>	839
Author Index	847