Assoc.Prof.Dr.Savas Dilibal

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RESEARCH INTEREST

Mechatronics, biomedical and biomechatronic applications of smart adaptronic systems. Systematic investigation on additively manufactured sensors & actuators for custom soft robotics systems, particularly soft robotic gripper systems. Position/force feedback analysis of the untethered soft robotic systems. Cyclic mechanical and thermo-mechanical stabilization, and system response of the cobots, EBM-based 3D/4D additive manufacturing of shape memory components and robotic wire arc additive manufacturing.

EDUCATION

Post-doctorate, Mechanical Science and Engineering
University of Illinois at Urbana-Champaign, Illinois, USA — Aug 2010

Doctor of Philosophy, Metallurgical and Materials Engineering
Yildiz Technical University, Istanbul, Turkey — Dec 2005

Master of Engineering, Mechanical Engineering
Istanbul Technical University, Istanbul, Turkey — June 2003

Bachelors of Engineering, System Engineering
Army Military Academy, Ankara, Turkey — Aug 1995

WORK EXPERIENCE

- *Associate Professor, Mechatronics Engineering. Dep.,* ***Istanbul Gedik University, Istanbul*** *Jan 2019 -Present*

- *Assistant Professor, Mechatronics Engineering. Dep.,* ***Istanbul Gedik University, Istanbul*** *Jan 2015 - 2019*

- *Adjunct Professor, Mechatronics Eng. Department,* ***Bahcesehir University, Istanbul*** *June 2014 - Jan 2015*
  - *Courses Taught:*
    MCH2011 "Static and strength of Materials", (Course content: Force Systems, Equilibrium, Strength of Materials, Stress & Strain, Mechanical Properties of Materials, Axial Load, Torsion, Bending, Transverse Shear"

- *Adjunct Professor, Mechanical Engineering Department,* ***Akron University, Akron, OH*** *Jan 2014 - June 2014*
  - *Courses Taught:*
    ME 4900- 420 "Object-oriented Design & Material Selection", (Course content:
    The course provides the most advanced portion of the systems component of the Aerospace Systems Engineering program. It provides a baseline for engineering practice on aerospace material selection following the co-op experience)

- *Research Associate,* ***University of Akron, Akron, OH*** *Jan 2014 - June 2014*

  NiTi shape memory alloys based solid-state actuators (Experimental investigation on bio-inspired robotics finger, hand and gripper mechanisms and their controlling modes)

- *Research Associate,* ***University of Akron, Akron, OH*** *Jan 2013 - Jan 2014*

  Experiment, modeling and applications of NiTi and NiTiHf shape memory alloys
  NASA*-funded project (NASA`s Subsonic Fixed Wing Program - NNX11AI57A)*

- *Adjunct Professor, Mechanical Engineering Department,* ***Yeditepe University, Istanbul*** *Sept 2007 - Sept 2009*
  - Courses Taught:
    ME 361 "Engineering Materials", (Course content: Production, processing and heat treatment of steel, aluminum, magnesium, titanium and nickel alloys, temperature-time-transformation diagrams, Metals in biomedical applications, Ceramic materials, Polymeric materials, Composite materials)

    ME 492 "SMA based robotic actuator system" Senior Mechanical Eng. Design Project

- *Plan Officer (NATO & Turkish Land Forces)* *Aug 1995 - Dec 2012*
  - As a system engineer, functioned in multiple national and NATO-led multinational headquarters

COMPUTER SKILL

Finite Element Analysis **:** ABAQUS® (CAE®/Standard/Explicit) Linear & non-linear, Static & dynamic analyses, UMAT

Object-oriented Programming **:** C# Microsoft Visual Studio

Mathematical Data Analysis Tools: Mathematica, MATLAB®, MS – Excel

Robot Wire-Arc-Additive-Manufacturing (WAAM): CAD/CAM Offline Programming Software, RoboDK

SUPERVISED GRADUATE THESES

G.S. Altug Peduk, Additive manufacturing, characterization and properties of nickel-titanium alloys, Istanbul Gedik University Institute of Science and Technology, Defense Technologies Program, **PhD Thesis**, 2017.

C. Ozbaran, Mechatronic system design of the autonomous warehouse mobile robot, Mechatronics Engineering Program, **Master's Thesis**, 2020.

E.T. Gulnergiz, Mechatronic system design of a hand rehabilitation orthosis with additive manufactured pneumatic artificial muscle, Mechatronics Engineering Program, **Master's Thesis**, 2020.

L.A. Gaga, The analysis of parameters affecting machining of carbon prepreg composite materials used in aerospace industry, **Master's Thesis**, 2020.

B. Bozkurt, Experimental and numerical analysis for the effect of embedded advanced engineering materials on thermal behavior of thermoelectric module, **Master's Thesis**, 2020.

G. Sorarli, Development of a pneumatic underwater robotic cutter prototype oriented for moored sea mine destruction, Defense Technologies Program, **Master's Thesis**, 2019.

K. Tanrıver, Separation of polymeric materials by recycling system, Istanbul Gedik University Institute of Science and Technology, Mechatronics Engineering Program, **Master's Thesis**, 2018.

T. Akkus, Determination of the measurement of dimension, volume and weight of passenger luggage using RBG-D camera and load cell at the airports, Istanbul Gedik University Institute of Science and Technology, Mechatronics Engineering Program, **Master's Thesis**, 2015.

SCI-SCI EXPANDED JOURNAL PUBLICATIONS

1. **Dilibal S.,** Sahin H., Owusu Danquah J., Choi, JW Additively Manufactured Custom Soft Gripper with Embedded Soft Force Sensors for an Industrial Robot, Additive Manufacturing **(under review)**

2. M Lin, M Vatani, JW Choi, **S Dilibal**, ED Engeberg **(2020)** Compliant underwater manipulator with integrated tactile sensor for nonlinear force feedback control of an SMA actuation system, Sensors and Actuators A: Physical 315 doi.org/10.1016/j.sna.2020.112221

3. Ades C.J., **Dilibal S.**, Engeberg ED **(2020)** Shape memory alloy tube actuators inherently enable internal fluidic cooling for a robotic finger under force control, Smart Materials and Structures, 29 Doi.org/10.1088/1361-665X/ab931f

4. **Dilibal S. (2018)** Stabilized actuation of a novel NiTi shape memory alloy actuated flexible structure under thermal loading. Materiali in Tehnologije, 52(5), 599-605, Doi: 10.17222/mit.2018.042

5. **Dilibal S.**, Sahin H., Çelik Y. **(2018)** Experimental and numerical analysis on the bending response of the geometrically gradient soft robotics actuator. Archives of Mechanics, 70(5), 391-404, Doi: 10.24423/aom.2903

6. Peduk G., **Dilibal S.**, Harrysson O., Ozbek S., West H. **(2018)** Characterization of Ni–Ti alloy powders for use in additive manufacturing. Russian Journal of Non-Ferrous Metals, 59(4), 433-439, Doi: 10.3103/S106782121804003X

7. **Dilibal S.**, Hamilton R. F, Lanba A. **(2017)** The effect of employed loading mode on the mechanical cyclic stabilization of NiTi shape memory alloys. Intermetallics, 89, pp.1-9, Doi: 10.1016/j.intermet.2017.05.014

8. **Dilibal S.**, Sahin H., Dursun E., Engeberg E.D. **(2017)** Nickel–titanium shape memory alloy-actuated thermal overload relay system design. Electrical Engineering, 99(3), 923930, Doi: 10.1007/s00202-016-0458-2

9. Engeberg E.D, **Dilibal S.,** Vatani M., Choi JW and Lavery J. **(2015)** Anthropomorphic finger antagonistically actuated by SMA plates, Bioinspiration & Biomimetics,; 10 (5): 056002 DOI: 10.1088/1748-3190/10/5/056002.

10. Saleeb A., Dhakal B., **Dilibal S.**, Owusu-Danquah J., Padula II S. **(2015)** On the modeling of the thermo-mechanical responses of four different classes of NiTi-based shape memory materials using a general multi-mechanism framework. Mechanics of Materials, 80, 6786, Doi: 10.1016/j.mechmat.2014.09.001

11. **Dilibal S. (2013)** Investigation of nucleation and growth of detwinning mechanism in martensitic single crystal NiTi using digital image correlation. Metallography, Microstructure, and Analysis, 2(4), 242-248., Doi: 10.1007/s13632-013-0083-7

12. **Dilibal S.**, Sehitoglu H., Hamilton R.F., Maier H.J., Chumlyakov Y. **(2011)** On the volume change in Co–Ni–Al during pseudoelasticity. Materials Science and Engineering: A, 528(6), 28752881, Doi: 10.1016/j.msea.2010.12.056

13. Hamilton RF, **Dilibal S.**, Sehitoglu H., Maier HJ **(2011)** Underlying mechanism of dual hysteresis in NiMnGa single crystals. Materials Science and Engineering: A, 528(3), 1877-1881, Doi: 10.1016/j.msea.2010.10.042

14. **Dilibal S.**, Tabanli R. M., Dikicioglu A. **(2004)** Development of shape memory actuated ITU Robot Hand and its mine clearance compatibility. Journal of Materials Processing Technology, 155156, 1390-1394, Doi: 10.1016/j.jmatprotec.2004.04.221

15. **Dilibal S.**, Guner E., Akturk N. **(2002)** Three-finger SMA robot hand and its practical analysis. Robotica, 20(02), 175-180, Doi: 10.1017/S0263574701003757

OUTHER PUBLICATIONS

1. Ozbaran C., **Dilibal S. (2020)** Mechatronic system design of a smart mobile warehouse robot for automated storage/retrieval systems, IEEE Innovations in Intelligent Systems and Applications Conference, 15-17 October, 2020

2. Ozbaran C., **Dilibal S. (2020)** Parallel jaw robotic gripper design and production with additive manufacturing method by using horizontal and vertical rack and pinion gear mechanism, Int. J. of 3D Printing Tech. Dig. Ind., 4(2): 139-151

3. **Dilibal S**, Owusu-Danquah J. **(2019)** The effect of contact surface on the grasping capability of additively manufactured soft robotic gripper, 4th International Congress on 3D Printing (Additive Manufacturing) Technologies and Digital Industry, 372-377, Antalya, ISBN: 978-975-96797-3-6

4. Peduk G., **Dilibal S.**, Harrysson O. and Ozbek S. **(2019)** Investigation of microstructural behavior of nickel-titanium alloy produced via additive manufacturing, 4th International Congress on 3D Printing (Additive Manufacturing) Technologies and Digital Industry, 1139-1143, Antalya, ISBN: 978-975-96797-3-6

5. Peduk G., **Dilibal S.**, Ozbek S. and Harrysson O. **(2018)** Evaluation of the structural differences between additive manufacturing and traditional manufacturing for production of nickel-titanium alloys. 3rd International Congress on 3D Printing Technologies, 370-371, ISBN: 978-975-96797-2-9

6. **Dilibal S.**, Sahin H. Candas C. **(2018)** Flexible wing design and additive manufacturing for new generation bioinspired unmanned aerial vehicles. 3rd International Congress on 3D Printing Technologies, 36-37 ISBN: 978-975-96797-2-9

7. Elbaba O., Sezer S., Sahin H., **Dilibal S. (2018)** Analysis of the basic parameters of additively manufactured elastomeric materials, International Journal of 3D Printing Technologies and Digital Industry 2:1 69-75.

8. **Dilibal S**., Sahin H., **(2018)** Collaborative industrial robots and digital industries, International Journal of 3d Printing Technologies and Digital Industry 2:1 86-95.

9. **Dilibal S. (2017)** The effect of heat treatment on the superelastic behavior of nickel-titanium shape memory alloys. Polytechnic Journal, 20(3), 623-627. Doi: 10.2339/politeknik.339387.

10. **Dilibal S. (2016)** The effect of long-term heat treatment on the thermomechanical behavior of NiTi shape memory alloys in defense and aerospace applications. Defense Science Journal, 15(2), 1-23.

11. Altug G., Ozistek TD., **Dilibal S.**, Ozbek S. **(2015)** Transparent armour systems and general applications, MSI May,3.

12. **Dilibal S.**, Engeberg E.D. **(2015)** Finger-like manipulator driven by antagonistic NiTi shape memory alloy actuators, IEEE International Conference on Advanced Robotics, Istanbul

13. Akkus T., **Dilibal S. (2015)** The use of image processing technique on the touchless volume and dimension measurements of passengers lagguage and cargo, Automation.

14. **Dilibal S.**, Tansug D., Kocak M. **(2015)** Operator training on robot, mechanized and orbital welding, IXth National Welding Congress, Ankara.

15. **Dilibal S.**, Tabanli M, Dikicioglu A. **(2003)** Development of shape memory actuated ITU Robot Hand and its mine clearence compatibility, Proceeding of AMPT03, 8-11 July 2003, Dublin, Ireland.

16. **Dilibal S.**, Sonmez N, Dilibal H. **(2003)** Nickel-titanium shape memory alloys and their technological usage, 3rd International Advanced Technology Symposium, 18-20 August, Ankara.

17. **Dilibal S.**, Dilibal H. **(2002)** ITUHand Robotic Hand and its mine clearance compatibility, pp.31-37, Defense Technology Congress, METU.

18. **Dilibal S**, Guner E. **(2000)** Design of three-finger shape memory alloy actuated SMA robot hand and application analysis. DokuzEylül University Engineering Faculty, Engineering Journal, 2(1), 159-173.

19. **Dilibal S.**, Güner E., **(1999)** Three fingered SMA robotic hand, XXth National Operations Research and Industrial Engineering Congress, Army Military Academy, Ankara, June 8-9, pp.98-99.

CONFERENCES

1. Bozkurt B., **Dilibal S.,** Sahin M.Y. **(2019)** Investigation of the cooling performance of the thermoelectric modules for mobile cooling system, International Conference on Energy and Sustainable Built Environment, June 19-20

2. Gulnergiz, E.T., Yekdaneh, A., **Dilibal, S**., Sahin, H. **(2019)** Multiple Degrees of Freedom Pneumatic Rehabilitation Orthosis Produced By Additive Manufacturing Method, National Robotic Conference, June 26-28, 2019, ISBN: 978605625160.

3. Yuguran E., **Dilibal S.,** Icli D., Cetinkaya F., Macit U., Sonmez E., Karakaya E., Lale B. **(2019)** Mechatronic system design of semi-autonomous unmanned underwater robot system, National Robotic Conference, June 26-28, 2019, ISBN: 978605625160.

4. Peduk G., **Dilibal S.,** Ozbek S., Harrysson O. **(2017)** Comparison of the production processes of nickel-titanium shape memory alloy through additive manufacturing. International Symposium on 3D Printing Technologies 3D-PTS2017, 391-399.

5. Ades, C., **Dilibal S.,** Engeberg ED. **(2016)** Exoskeleton for Tubular Shape Memory Alloy Finger with Internal Cooling and A Superelastic SMA Spring Return, ASME Florida Conference on Recent Advances in Robotics,

Miami, Florida, USA

6. Tepeyurt S., **Dilibal S.**, Sahin H. **(2016)** Design of industrial robot gripper using additive manufacturing technique and manipulation by operator joint movements. Robot Science Conference (ToRK-2016), 135-137.

7. Yurtsever O., **Dilibal S. (2014)** Material characterization of nickel-titanium root canal files used in endodontic treatment. IV. Workshop on Advanced Technologies (ITC-2014)

8. Aktas G., Atapek H., Polat S., **Dilibal S. (2014)** Physical metallurgical approaches for shape memory alloys used in earthquake engineering. Workshop on Advanced Technologies (ITC-2014)

9. **Dilibal S.**, Kazancı M. **(2014)** Bioengineering applications of metallic and polymeric smart materials. Workshop on Advanced Technologies (ITC-2014)

10. **S. Dilibal**, A. F. Saleeb, B. Dhakal, A.E. Hurley, J. S. Owusu-Danquah, S. A. Padula II, R. D. Noebe and G. S. Bigelow **(2013)** Characterization Capabilities of a 3D Multi-mechanism Material Model for the Prediction of the Thermo-mechanical Behavior of Different Classes of Shape Memory Materials, ASME 2013 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, September 16-18, 2013 in Snowbird, Utah, USA (Symposium 2 on Mechanics and Behavior of Active Materials).

11. J.S. Owusu-Danquah, A. F. Saleeb, B. Dhakal, A.E. Hurley , **S. Dilibal**, S. A. Padula II, R. D. Noebe, and G. S. Bigelow **(2013)** Large-scale Simulation of a Torque-Tube Actuator Using a 3D Multi-mechanism Material Model: A Comparative Study with $Ni_{49.9}Ti_{50.1}$ and $Ni_{50.3}Ti_{29.7}Hf_{20}$ Shape Memory Alloys, ASME 2013 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, September 16-18, 2013 in Snowbird, Utah, USA (Symposium 2 on Mechanics and Behavior of Active Materials).

12. A.E. Hurley, A. F. Saleeb, **S. Dilibal**, B. Dhakal, J.S. Owusu-Danquah, and S. A. Padula II **(2013)** Finite Element Modeling of NiTi Shape Memory Alloy Stents and Bone Staples for Biomedical Applications, ASME 2013 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, September 16-18, 2013 in Snowbird, Utah, USA (Symposium 2 on Mechanics and Behavior of Active Materials).

13. **S. Dilibal**, H. Sehitoglu, R. Hamilton, H.J.Maier, Y. Chumlyakov **(2010)** Detwinning on NiTi SMAs, June 20-24, 2010, Special Workshop on Shape Memory Alloy, Koc University, Istanbul.

14. **S. Dilibal**, N. Cansever **(2008)** Material characterization of the manufactured NiTi SMAs, The International Conference for Shape Memory and Superelastic Technologies (SMST), 21-25 Sept., Stresa, Italy.

BOOKS AND SECTIONS IN BOOKS PUBLISHED INTERNATIONALLY

1. Editor: **Dilibal S.,** Şahin E., Şahin H., Kalkan S., Sariel S. **(2017).** Robot Science Conference (ToRK-2016) Conference Proceeding. Istanbul Gedik University, ISBN: 9786058557215.

2. **Dilibal S.** and Sahin H. **(2019)** Application of additive manufacturing with robotic arc welding within the scope of Industry 4.0, In Cetinkaya C, Demircioglu P, Ozsoy K, Duman B (Eds.) Industry 4.0 technological fields and applications, Pegem Academy, ISBN: 9786050370072.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

1. Member, ASME Turkey Section

2. International Congress on 3D Printing (Additive Manufacturing) Technologies and Digital Industry Advising Committee Member – www.3dprintturkey.org

3. National Robot Science Conference (ToRK), Advising Committee Member - www.tork.org.tr

4. IAESTE University Representative – www.iaeste.org.tr

5. IEEE International Conference on Research and Education in Mechatronics **(REM)**, International Steering Committee Member

PATENT ISSUED

1. **Dilibal S.,** Engeberg ED., Antagonistically actuated shape memory alloy manipulator, **USPTO 2017, 9744055 B2 USA**

2. **Dilibal S.,** Key and safe padlock system using nickel-titanium shape memory alloys, **TR 2008 02546 B**

3. Emeksiz C., **Dilibal S**., Prismatic wind turbine blade connection developed using superelastic nickel-titanium alloy, **TR 2014 11465B**

4. Sener A., Igci A., Sahin H., Kalaycı M.U., **Dilibal S.,** Oncul M.O., Gastric bypass tube for bariatric purposes **TR 2017 07156 (pending)**

5. **Dilibal S.,** N. Geyik Degerli, Production of woven fabric using nickel-titanium/para-aramid filament **TR 2016 04097**

6. Sorarlı G., **Dilibal S.,** Sahin H., Underwater robotic cutter oriented for moored sea mine destruction, TR 2019 15901 **(pending)**

PROJECTS DIRECTED AND PARTICIPATED

2017 (Executive) Istanbul Gedik University – ASELSAN, Design of nickel-titanium shape memory alloy actuated underwater winglet system (IU0002-17I), Jan 2017 – July 2017

2013-2014 (Researcher) NASA Research Project, Modeling of nickel-titanium shape memory alloys based actuator (**NASA Glenn Research Center, Fundamental Aeronautics Program, Subsonic Fixed-Wing Project No.NNH10ZEA001N-SFW1, Grant No.: NNX11AI57A**) University of Akron - NASA GRC, Ohio Jan 2013- Jan 2014

ADMINISTRATIVE POSITIONS

2014 –Present, Head of Mechatronics Engineering Department at Istanbul Gedik University

2014 –Present, Director of Robot Tech Research and Application Center at Istanbul Gedik University

2014 - 2018, Vice Director of Institute of Science and Technology at Istanbul Gedik University

REFERENCES

Dr. Erik D. Engeberg
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Boca Raton, FL 33431
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