DSTA 2021 dys-ta.com
16th INTERNATIONAL CONFERENCE
Dynamical Systems – Theory and Applications
December 6-9, 2021, On-line

Roughness evaluations for metallic parts using optical coherence tomography (OCT)

VIRGIL-FLORIN DUMA[1,2*], GHEORGHE HUTIU[1], ALEXANDRU-LUCIAN DIMB[2], DORIN DEMIAN[1], ADRIAN BRADU[3], ADRIAN PODOLEANU[3]

1. 3OM Optomechatronics Group, Aurel Vlaicu University of Arad, 77 Revolutiei Ave., 310130 Arad, Romania [http://orcid.org/0000-0001-5558-4777]
2. Doctoral School, Polytechnic University of Timisoara, 1 Mihai Viteazu Ave., 300222 Timisoara, Romania
3. School of Physical Sciences, University of Kent, Canterbury, United Kingdom, CT2 7NR

* Presenting Author

Abstract: Roughness parameters are essential to characterize the quality of mechanical parts. Their most common evaluation method uses mechanical profilometers. The aim of this work is to use a non-contact method, Optical Coherence Tomography (OCT) [1,2], to assess roughness of different metallic materials processed with several types of methods, including milling and turning. An in-house developed swept source (SS), Master-Slave (MS) enhanced OCT system is employed [3]. Using the interferometry capabilities of OCT, a (large) number of profiles can be determined in milliseconds on the metallic surface. A processing algorithm of the retrieved data is developed. The obtained roughness parameters are compared with those provided by profilometers. Advantages of drawbacks of each method are discussed. This work comes in the context of previous researches where we demonstrated that OCT can replace the gold standard of Scanning Electron Microscopy (SEM) in evaluating the different types of fractures of metallic materials [4,5]. Thus, while OCT is most useful because of its cross-sectional capability of non-reflective materials, optical profilometry of metallic parts can become a valuable tool in Non-Destructive Testing (NDT) of mechanical systems.

Keywords: roughness, metallic surfaces, optical coherence tomography (OCT), low coherence interferometry, signal processing, mechanical profilometer, measuring systems.

Acknowledgment: This research is supported by the Romanian Ministry of Research, Innovation and Digitization, through CNCS/CCCDI–UEFISCDI project PN-III-P2-2.1-PED-2020-4423, within PNCDI III (http://3om-group-optomechatronics.ro/).

References

[1] HUANG D, SWANSON EA, LIN CP, SCHUMAN JS, STINSON WG, CHANG W, HEE MR, FLOTTE T, GREGORY K, PULIAFITO CA, FUJIMOTO JG: Optical coherence tomography. *Science* 1991, **254**:1178-1181.

[2] DREXLER W, LIU M, KUMAR A, KAMALI T, UNTERHUBER A, LEITGEB RA: Optical coherence tomography today: speed, contrast, and multimodality. *J. Biomed. Opt.* 2014, **19**:071412.

[3] PODOLEANU A, BRADU A: Master–slave interferometry for parallel spectral domain interferometry sensing and versatile 3D optical coherence tomography. *Opt. Express* 2013, **21**:19324–19338.

[4] HUTIU G, DUMA V-F, DEMIAN D, BRADU A, PODOLEANU AG: Surface imaging of metallic material fractures using optical coherence tomography. *Appl. Opt.* 2014, **53**(26):5912-5916.

[5] HUTIU G, DUMA V-F, DEMIAN D, BRADU A, PODOLEANU AG: Assessment of Ductile, Brittle, and Fatigue Fractures of Metals Using Optical Coherence Tomography. *Metals* 2018, **8**:117.