Dr. Vigneashwara Pandiyan

Curriculum Vitae

University Lecturer | University of Turku

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Degrees

- 31 March 2019, Doctor of Philosophy, Mechanical and Aerospace Engineering, Nanyang Technological University (NTU), Singapore. Thesis: *Modelling and in-process monitoring of abrasive belt grinding process*. The doctoral work was conducted in connection with the Rolls-Royce@NTU Corporate Laboratory, Singapore.
- August 2014, Master of Science in Precision Engineering, NTU, Singapore. Thesis: *Experimental investigation of high frequency media finishing process* conducted in Rolls-Royce, Singapore. Graduated with Certificate of Excellence / First-Class Honours, CGPA 4.56/5.00.
- May 2011, Bachelor of Engineering in Aeronautical Engineering, Anna University, India / Hindustan College of Engineering, Chennai, India.

Other education and expertise

- Pedagogical studies: Completed the University Teaching for Teaching Assistants course at NTU, Singapore, in November 2015.
- Teaching demonstration / formal teaching evaluation: Teaching demonstration given at UTU on 4 June 2024 for the University Lecturer position; assessed with the grade *excellent*.

Current employment

January 2025–present

University Lecturer
Department of Mechanical and Materials Engineering, Faculty of Technology, University of Turku; member of the Digital Manufacturing and Surface Engineering (DMS) research group.

- Job description: Advances data-driven and physics-aware manufacturing through multi-sensor fusion, signal analytics, and machine learning (ML) frameworks for intelligent and sustainable production; investigates photon and phonon emissions during material transformations; leads and contributes to research on laser–material interaction monitoring, digitalization of additive and subtractive manufacturing, and tribo-informatics integrating contact mechanics, acoustic emissions, optical emissions, and predictive modelling.
- Teaching responsibilities: Research-driven teaching and course coordination in ML for manufacturing, digital manufacturing, materials processing, surface engineering, process monitoring, non-destructive testing, and signal/data analytics for manufacturing.
- Technical Lead and Principal Investigator of MPRINT, a Business Finland Research to Business project focused on translating advanced manufacturing concepts towards commercialization. Main Principal Investigator at UTU for INTELLASE, a Horizon Europe Marie Skłodowska-Curie Doctoral Network (MSCA-DN) on intelligent laser precision manufacturing. The project supports doctoral training, international collaboration, distributed process intelligence, and physics-informed sensing for laser-based processes. Responsible for the supervision of two PhD researchers.

Previous research experience

December 2023–
January 2025

Senior Researcher
Additive Manufacturing / Digital Manufacturing, Advanced Materials Division / Advanced Materials Research Centre, Technology Innovation Institute (TII), Abu Dhabi, United Arab Emirates.

- Led research on real-time monitoring and control of metal additive manufacturing using multi-sensor analytics and ML.
- Developed artificial intelligence (AI)-based powder bed fusion–laser beam (PBF-LB) process maps and digital-twin frameworks for process qualification and autonomous control.
- Supervised an industrial PBF-LB platform and developed collaborations in the Middle East.

October 2019–
November 2023

Scientist
Laboratory for Advanced Materials Processing, Swiss Federal Laboratories for Materials Science and Technology (Empa), Switzerland.

- Pioneered multimodal sensing and AI-based process monitoring for PBF-LB, directed energy deposition (DED), laser processing, and tribological contact studies.
- Integrated acoustic and optical sensing with operando synchrotron X-ray diagnostics.
- Developed transfer-learning, contrastive-learning, self-supervised-learning, and explainable-AI methods for cross-material and cross-process monitoring.
- Collaborated with PSI, EPFL, ETH Zurich, AC2T, KU Leuven, Fraunhofer ILT, Bystronic, Synova, and other partners.
- Co-led SFA-AM (MOCONT), MAMAI – In situ monitoring in additive manufacturing of metals and alloys based on artificial intelligence, and Innosuisse-related initiatives.

October 2018–
September 2019

Research and Development Scientist
Advanced Remanufacturing and Technology Centre (ARTC), Agency for Science, Technology and Research (A*STAR), Singapore.

- Developed smart-manufacturing and industrial Internet of Things (IIoT) solutions for industrial digitalization.
- Designed sensorization and data-streaming architectures for machine-utilization monitoring with SAESL.
- Applied deep learning to hyperspectral quality control for FMCG powder production with Nestlé, Singapore.
- Developed predictive-maintenance methods using programmable logic controller (PLC) data and ML for Rolls-Royce and SKF.
- Contributed to machine-vision applications in the Model Factory / Factory of the Future initiative.

August 2014–
September 2018

Researcher / PhD Research Scholar
Rolls-Royce@NTU Corporate Laboratory, NTU, Singapore.

- Conducted doctoral research on abrasive-belt grinding process modelling and in-situ monitoring.
- Developed multi-sensor feature-learning methods and AI-based models for tool-wear detection, weld-seam removal, material-removal characterization, and monitoring of robotic abrasive-belt grinding.
- Identified dominant frequency modes linked to tribological material-removal mechanisms.

July 2011–
July 2013

Software Test Engineer
Larsen & Toubro Infotech / Mindtree, Mumbai and Chennai, India.

- Contributed to industrial automation and software-quality assurance through requirements analysis, multi-environment testing, compliance verification, defect analysis, reporting, and presentation.

Research funding and grants

- **INTELLASE – Intelligent Laser Precision Manufacturing**, Horizon Europe MSCA-DN. Role: Main Principal Investigator at UTU. The project advances intelligent laser precision manufacturing through physics-based modelling, real-time multimodal sensing, and AI-driven process monitoring and control. The UTU contribution, through the DMS group, focuses on distributed process intelligence for monitoring laser–material interactions and the development of physics-informed sensing architectures for laser-based processes. The project will also support doctoral training at UTU through the hosting and supervision of two doctoral candidates. Start date: January 2027. Amount: approximately €600K.

Research output

Google Scholar
2,364
Citations
26 h-index
30 i10-index

ResearchGate
2,053
Citations
58 Listed research outputs

Scopus
1,849
Citations
24 h-index
41 Documents

Peer-reviewed output
35+
Journal and conference publications

Metrics retrieved on 2 October 2026. Google Scholar figures are from public search listings. Scopus figures are from the supplied profile screenshot. ResearchGate outputs include articles, conference papers, preprints, and datasets.

Research themes: Turning physics & data into insights; Physics-based investigation of material transformations driven by *contact mechanics* and *laser–material interactions*, using emitted *photons* and *phonons* to uncover the mechanisms governing deformation, material removal, melting, solidification, and damage. Integration of optical and acoustic measurements with *Machine Learning (ML)* for process sensorization and identification of underlying physical states from observable emissions. Development of physics-informed approaches to *process monitoring*, *process control*, and automation in *Smart Manufacturing* and *Triboinformatics*, with an emphasis on improving *process quality* through mechanistic understanding.

Open research outputs: Publicly shared multi-sensor datasets and source code supporting reproducible process monitoring, sensor fusion, self-supervised learning, domain adaptation, and explainable AI for manufacturing.

Explore research records: ORCID | Scopus | Web of Science | GitHub

Research supervision and leadership experience

- More than 10 years of supervision and mentoring experience with undergraduate, master's, and doctoral students across Finland, Switzerland, Singapore, and international collaborative projects.
- Supervised and mentored 5 PhD, 4 MSc, and 4 BEng students across UTU, Empa–EPFL, A*STAR, NTU, and AC2T. The supervised work covered smart manufacturing, process monitoring, additive manufacturing, tribology, predictive maintenance, multimodal sensing, and ML. This includes thesis-related collaboration with EPFL and AC2T doctoral researchers, internship supervision at NTU, guidance of three NTU graduate students towards dissertation work, supervision of four NTU undergraduate final-year projects, and service as a graduate teaching assistant in laboratory modules for second- and third-year undergraduate students.
- Leadership experience: Technical Lead and Principal Investigator of MPRINT, Business Finland Research to Business project; co-led Innosuisse, MAMAI – In situ monitoring in additive manufacturing of metals and alloys based on artificial intelligence, and SFA-AM (MOCONT) initiatives at Empa with PSI, EPFL, Fraunhofer ILT, and industrial partners; managed digitalization programmes at A*STAR with Rolls-Royce, Nestlé, SAESL, and SKF.
- At UTU: Co-supervising 2 PhD students in the Department of Mechanical and Materials Engineering in research planning, experimental and analytical work, manuscript preparation, and the development of new academic and industrial collaborations.

Teaching merits

- Pedagogical training: University Teaching for Teaching Assistants, NTU, Singapore. Date of completion: November 2015.
- UTU teaching, January 2025–present:
  - KTEK0070 – Machine Learning in Digital Manufacturing, master's level, course coordinator.
  - KTEK0033 – Materials Processing Technologies in Digital Manufacturing, master's level, lecturer; emphasis on solidification phenomena, field-assisted manufacturing, laser-assisted manufacturing, and material transformations during melting and resolidification.
  - KTEK0035 – Advanced Surface and Coating Technology, master's level, lecturer; lecture modules on grinding principles and modern surface engineering.
  - Åbo Akademi University, NM00CW34 – Additive Manufacturing with Bio-based Materials and Biopolymers; teaching contribution.
  - KTEK0068 – Welded Metal Structures, bachelor's level, lecturer; non-destructive testing of welded structures.
- Teaching demonstration / formal teaching evaluation: Teaching demonstration given at UTU on 4 June 2024 for the University Lecturer position; assessed with the grade *excellent*.
- Teaching and mentoring at NTU, Empa, and EPFL, July 2015–November 2023: Served as a graduate teaching assistant at NTU, taught laboratory modules for second- and third-year undergraduate students, and guided graduate and undergraduate student projects. At Empa/EPFL, designed and tutored master's-level teaching activities in *Materials Processing with Intelligent Systems* and collaborated with doctoral and graduate students on thesis-related research.
- Teaching philosophy and expertise: Research-led learning, practical data-driven experimentation, and linking fundamental process mechanisms to digital manufacturing tools; emphasis on responsible use of ML through attention to process physics, sensor placement, data quality, interpretability, validation, and manufacturing deployment.

Awards and honours

- Certificate of Excellence, NTU, Singapore, 2014, for academic performance in the Master of Science in Precision Engineering programme; First-Class Honours, CGPA 4.56/5.00.
- External expert honorarium, European Science Foundation, 2026, for service as an expert in the assessment process for FWO-PDOC-2025_Sci-Tech.
- **Stanford–Elsevier World's Top 2% Scientists (2026 edition).** Included in the single-year citation-impact category for 2025 in *Industrial Engineering & Automation*.

Personal Information

- Native language: Tamil.
- English: professional working proficiency / academic working language.
- Date of Birth: 23rd February 1990.
- Nationality: Indian.
- Married: Yes.
- Spouse name: Mala jawahar.
- Daughter: Nila.

References

Dr Tegoeh Tjahjowidodo
Associate Professor, KU Leuven. Manufacturing Processes and Systems (MaPS), De Nayer (Sint-Katelijne-Waver) Campus. Jan Pieter de Nayerlaan 5, 2860 Sint-Katelijne-Waver. Room: 01.G116.
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Dr Sathyan Subbiah
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Dr Christian Leinenbach
Head of the Advanced Processing and Additive Manufacturing group and deputy head at the Laboratory for Advanced Material Processing, Empa.
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Publications

ResearchGate; Google Scholar; ORCID; Scopus; Web of Science.

1. *Vigneashwara Pandiyan*, Rafał Wróbel, Sergey Shevchik, and Christian Leinenbach. "Explainable zero-shot transfer learning for cross-domain In-Situ acoustic monitoring in laser powder bed fusion process using learnable wavelet scattering." Materials & Design (2026): 115888.

2. *Vigneashwara Pandiyan*, Antonios Baganis, Antti Salminen, and Christian Leinenbach. "Learning composition-sensitive signatures in multi-material PBF-LB: a lightweight, modality-aware, explainable graph-attention sensor fusion framework for in-situ monitoring of graded 316L–CuCrZr alloys." Progress in Additive Manufacturing (2026): 1-29.

3. Fardan, Ahmed, Gowtham Soundarapandiyan, *Vigneashwara Pandiyan*, Steven Van Petegem, Efthymios Polatidis, Sofia Kazi, Sneha Goel et al. "Unveiling crack mitigation pathways in powder bed fusion–laser beam of CM247LC: an operando X-ray radiography study of Hf and nano-Y2O3 additions." Progress in Additive Manufacturing (2026): 1-19.

4. Navarre, Claire, William Hearn, Mathijs Van der Meer, Lucas Schlenger, Rik Vaerenberg, Nicolas Mari, Reza Esmaeilzadeh, Amir Jamili , *Vigneashwara Pandiyan*, Steven Van Petegem , Roland E. Logé. "Exploring real-time monitoring of laser-induced recrystallization using acoustic emissions." Optics & Laser Technology 195 (2026).

5. Kavas, Barış, Roland Axel Richter, Michael R. Tucker, and *Vigneashwara Pandiyan*. "Adaptive In-Situ monitoring for laser powder bed Fusion: Self-Supervised learning for layer thickness monitoring across scan lengths based on pyrometry." Optics & Laser Technology 192 (2025): 114070.

6. *Vigneashwara Pandiyan*, Antonios Baganis, Roland Axel Richter, Rafał Wróbel, and Christian Leinenbach. "Qualify-as-you-go: sensor fusion of optical and acoustic signatures with contrastive deep learning for multi-material composition monitoring in laser powder bed fusion process." Virtual and Physical Prototyping 19, (2024).

7. Reza Esmaeilzadeh, *Vigneashwara Pandiyan*, Steven Van Petegem, Mathijs Van der Meer, Milad Hamidi Nasab, Charlotte de Formanoir, Jamasp Jhabvala et al. "Acoustic emission signature of martensitic transformation in laser powder bed fusion of Ti6Al4V-Fe, supported by operando X-ray diffraction." Additive Manufacturing 96 (2024).

8. *Vigneashwara Pandiyan*, Rafał Wróbel, Roland Axel Richter, Marc Leparoux, Christian Leinenbach, Sergey Shevchik. " Monitoring Of Laser Powder Bed Fusion Process By Bridging Dissimilar Process Maps Using Deep Learning-based Domain Adaptation on Acoustic Emissions." Additive Manufacturing (2024).

9. Akash Aggarwal, *Vigneashwara Pandiyan*, Christian Leinenbach, and Marc Leparoux. "Investigating laser beam shadowing and powder particle dynamics in directed energy deposition through high-fidelity modelling and high-speed imaging." Additive Manufacturing 91 (2024): 104344.

10. Pushkar Deshpande, Kilian Wasmer, Thomas Imwinkelried, Roman Heuberger, Michael Dreyer, Bernhard Weisse, Rowena Crockett, and *Vigneashwara Pandiyan*. "Classification of Progressive Wear on a Multi-Directional Pin-on-Disc Tribometer Simulating Conditions in Human Joints-UHMWPE against CoCrMo Using Acoustic Emission and Machine Learning." Lubricants 12, no. 2 (2024): 47.

11. *Vigneashwara Pandiyan*, Di Cui, Roland Axel Richter, Annapaola Parrilli, and Marc Leparoux. "Real-time monitoring and quality assurance for laser-based directed energy deposition: integrating co-axial imaging and self-supervised deep learning framework." Journal of Intelligent Manufacturing (2023): 1-25.

12. *Vigneashwara Pandiyan*, Rafał Wróbel, Christian Leinenbach, Sergey Shevchik "Optimizing in-situ monitoring for laser powder bed fusion process: Deciphering acoustic emission and sensor sensitivity with explainable machine learning." Journal of Materials Processing Technology 321 (2023): 118144.

13. Richter, Roland Axel, Falk Braunmüller, *Vigneashwara Pandiyan*, Sergey Shevchik, Toni Ivas, and Amédée Zryd. "Correlation of signal feature importance and process parameters in water jet-guided laser cutting." In IOP Conference Series: Materials Science and Engineering, vol. 1296, no. 1, p. 012044. IOP Publishing, 2023.

14. *Vigneashwara Pandiyan*, Rafał Wróbel, Roland Axel Richter, Marc Leparoux, Christian Leinenbach, Sergey Shevchik." Self-Supervised Bayesian Representation Learning of Acoustic Emissions from Laser Powder Bed Fusion Process for In-situ Monitoring" Materials & Design (2023)

15. Hamidi Nasab M, Masinelli G, de Formanoir C, Schlenger L, Van Petegem S, Esmaeilzadeh R, Wasmer K, Ganvir A, Salminen A, Aymanns F, Marone F, *Vigneashwara Pandiyan*, Sneha Goel and Roland E. Logé. Harmonizing sound and light: X-ray imaging unveils acoustic signatures of stochastic inter-regime instabilities during laser melting. Nature Communications. 2023 Dec 5;14(1):8008.

16. Roland Axel Richter, Gowtham Soundarapandiyan, *Vigneashwara Pandiyan*, Efthymios Polatidis, Eduard Hryha, Steven Van Petegem et al. "Monitoring of cracking in nickel superalloys during Laser powder bed fusion process with acoustic emission and operando X-ray radiography."AMSS 2023.

17. *Vigneashwara Pandiyan*, Masinelli, Giulio, Navarre Claire, Tri Le-Quang, Milad Hamidi-Nasab, Charlotte de Formanoir, Reza Esmaeilzadeh, Sneha Goel et al. "Deep Learning-Based Monitoring of Laser Powder Bed Fusion Process on Variable Time-Scales Using Heterogeneous Sensing and Operando X-Ray Radiography Guidance." Additive Manufacturing (2022)

18. *Vigneashwara Pandiyan*, Di Cu, Tri Le-Quang, Pushkar Deshpande, Kilian Wasmer and Sergey Shevchik, " In Situ Quality Monitoring in Direct Energy Deposition Process using Co-axial Process Zone Imaging and Deep Contrastive Learning." Journal of Manufacturing Processes (2022)

19. *Vigneashwara Pandiyan*, Di Cu, Annapaola Parrilli, Pushkar Deshpande, Giulio Masinelli, Kilian Wasmer and Sergey Shevchik, " Monitoring of direct energy deposition process using deep-net based manifold learning and co-axial melt pool imaging." Manufacturing Letters (2022)

20. Wasmer, Kilian, Matthias Wüst, Di Cui, Giulio Masinelli, *Vigneashwara Pandiyan*, and Sergey Shevchik. "Monitoring of functionally graded material during laser directed energy deposition by acoustic emission and optical emission spectroscopy using artificial intelligence." Virtual and Physical Prototyping 18, no. 1 (2023): e2189599.

21. *Vigneashwara Pandiyan*, Rita Drissi-Daoudi, Roland Logé, Sergey Shevchik, Giulio Masinelli, Hossein Ghasemi-Tabasi, Annapaola Parrilli, and Kilian Wasmer. "Differentiation of materials and laser powder bed fusion processing regimes from airborne acoustic emission combined with machine learning." Virtual and Physical Prototyping (2022): 1-24.

22. Masinelli, Giulio, Rafal Wrobel, *Vigneashwara Pandiyan*, and Kilian Wasmer. "Multimodal signal segmentation technique based on morphological operators applied on synchronized optical data for Laser Powder Bed Fusion processes." Procedia CIRP 111 (2022): 838-843.

23. *Vigneashwara Pandiyan*, Mehdi Akeddar, Josef Prost, Georg Vorlaufer, Markus Varga, Killian Wasmer. Long short-term memory based semi-supervisedencoder—decoder for early prediction of failures in self-lubricating bearings. Friction 2022. accepted for publication on 3 April 2022

24. *Vigneashwara Pandiyan*, Rita Drissi-Daoudi, Sergey Shevchik, Giulio Masinelli, Tri Le-Quang, Roland Logé, and Kilian Wasmer. "Deep transfer learning of additive manufacturing mechanisms across materials in metal-based laser powder bed fusion process." Journal of Materials Processing Technology 303 (2022): 117531.

25. *Vigneashwara Pandiyan*, Rita Drissi-Daoudi, Sergey Shevchik, Giulio Masinelli, Tri Le-Quang, Roland Logé, and Kilian Wasmer. "Semi-supervised Monitoring of Laser powder bed fusion process based on acoustic emissions." Virtual and Physical Prototyping (2021): 1-17.

26. *Vigneashwara Pandiyan*, Josef Prost, Georg Vorlaufer, Markus Varga, Killian Wasmer. Identification of Abnormal Tribological Regimes Using a Microphone And Semi-Supervised Machine-Learning Algorithm. Friction 2021. accepted for publication on 3 April 2021.

27. Deshpande, Pushkar, *Vigneashwara Pandiyan*, Bastian Meylan, and Kilian Wasmer. "Acoustic emission and machine learning-based classification of wear generated using a pin-on-disc tribometer equipped with a digital holographic microscope." Wear (2021): 203622.

28. Masinelli, Giulio, Sergey A. Shevchik, *Vigneashwara Pandiyan*, Tri Quang-Le, and Kilian Wasmer. "Artificial Intelligence for Monitoring and Control of Metal Additive Manufacturing." In International Conference on Additive Manufacturing in Products and Applications, pp. 205-220. Springer, Cham, 2020.

29. *Vigneashwara Pandiyan*, and Wahyu Caesarendra. "Distributed Analytics Framework for Integrating Brownfield Systems to Establish Intelligent Manufacturing Architecture." Industry 4.0: Current Status and Future Trends (2020): 103.

30. *Vigneashwara Pandiyan*, Rita Drissi-Daoudi, Sergey Shevchik, Giulio Masinelli, Roland Logé, and Kilian Wasmer. "Analysis of time, frequency and time-frequency domain features from acoustic emissions during Laser Powder-Bed fusion process." Procedia CIRP 94 (2020): 392-397.

31. *Vigneashwara Pandiyan*, Sergey Shevchik, Kilian Wasmer, Sylvie Castagne, and Tegoeh Tjahjowidodo. "Modelling and monitoring of abrasive finishing processes using artificial intelligence techniques: A review." Journal of Manufacturing Processes 57 (2020): 114-135.

32. *Vigneashwara Pandiyan*, Wahyu Caesarendra, Adam Glowacz, and Tegoeh Tjahjowidodo. "Modelling of material removal in abrasive belt grinding process: a regression approach." Symmetry 12, no. 1 (2020): 99.

33. *Vigneashwara Pandiyan*, Tegoeh Tjahjowidodo, "Use of Acoustic Emissions to detect change in contact mechanisms caused by tool wear in abrasive belt grinding process." Wear 436 (2019): 203047.

34. *Vigneashwara Pandiyan*, Pushparaja Murugan, Tegoeh Tjahjowidodo, Wahyu Caesarendra, Omey Mohan Manyar, and David Jin Hong Then. "In-process virtual verification of weld seam removal in robotic abrasive belt grinding process using deep learning." Robotics and Computer-Integrated Manufacturing 57 (2019): 477-487.

35. *Vigneashwara Pandiyan*, Wahyu Caesarendra, Tegoeh Tjahjowidodo, Hock Tan, "In-process tool condition monitoring in compliant abrasive belt grinding process using support vector machine and genetic algorithm", Journal of Manufacturing Processes, 31 (2018) 199-213.

36. *Vigneashwara Pandiyan*, Tegoeh Tjahjowidodo, Wahyu Caesarendra, Praveen G, Wijaya T, Pappachan BK. Analysis of Contact Conditions based on Process Parameters in Robotic Abrasive Belt Grinding Using Dynamic Pressure Sensor. Joint 10th International Conference on Soft Computing and Intelligent Systems (SCIS) 2018 Dec 5 (pp. 1217-1221). IEEE.

37. *Vigneashwara Pandiyan*, Tegoeh Tjahjowidodo. "In-process endpoint detection of weld seam removal in robotic abrasive belt grinding process". The International Journal of Advanced Manufacturing Technology (2017), 93(5-8), pp.1699-1714.

38. *Vigneashwara Pandiyan*, Wahyu Caesarendra, Tegoeh Tjahjowidodo, & Praveen Gunasekaran (2017). "Predictive Modelling and Analysis of Process Parameters on Material Removal Characteristics in Abrasive Belt Grinding Process". Applied Sciences 7, no. 4 (2017): 363.

39. *Vigneashwara Pandiyan*, Sylvie Castagne, Sathyan Subbiah, "High Frequency and Amplitude Effects in Vibratory Media Finishing", Procedia Manufacturing, Volume 5, 2016, Pages 546-557, ISSN 2351-9789.

40. *Vigneashwara Pandiyan*, Tegoeh Tjahjowidodo, "In-Process Surface Roughness Estimation Model for Compliant Abrasive Belt Machining Process", Procedia CIRP, Volume 46, 2016, Pages 254-257, ISSN 2212-8271.