Manoj Kumar Babu

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RESEARCH INTERESTS

- Digital Manufacturing, Applied Machine Learning and Statistical Modelling.

EDUCATION

WMG, University of Warwick — United Kingdom
PhD in Industrial Engineering — *Nov. 2014 – Jan. 2020*

Indian Institute of Technology (IIT) Kharagpur — India
Master of Technology in Industrial Engineering; GPA: 8.98/10.0 — *Jul. 2012 – Jun. 2014*

Aeronautical Society of India — India
Bachelor of Engineering in Aeronautics; Score: 68/100 (Best performance award) — *June. 2006 – Dec. 2010*

RESEARCH & INDUSTRIAL EXPERIENCE

WMG, University of Warwick — United Kingdom
Senior Teaching Fellow — *Feb 2020 – Till-date*
Leading the Development and delivery of the following WMG-Undergraduate modules: Data Science and Machine Learning, and, Vision and Image Processing.

WMG, University of Warwick — United Kingdom
Research Assistant — *Jan 2018 – Feb 2020*
In-Process Quality Improvement for digital manufacturing: Implemented a Spatio-Temporal Adaptive Sampling methodology for robotic optical 3D-surface scanners to reduce the measurement cycle time and enable in-line implementation of the scanner.

- Developed statistical modelling techniques to predict complete part deviations using partial measurement data from the scanner in real-time.
- Developed entropy based criterion to analyse measurement data from the scanner and adaptively choose critical measurement regions of the part in real-time.
- Utilised Cloud-of-Point data to identify root cause of geometric and dimensional errors using machine learning algorithms (CNNs).
- Developed change-detection methodology for quick identification and localisation of surface quality defects in the part.

WMG, University of Warwick — United Kingdom
Doctoral Student — *Nov 2014 – Jan 2020*
Developed methodologies to model spatial and spatio-temporal correlations in a manufacturing assembly system to improve product quality.

- **In-line Robotic Quality Inspection:** Developed a Spatio-Temporal Adaptive Sampling methodology for optical 3D-surface scanners to reduce the measurement cycle time and enable in-line implementation of the scanner.
- **Manufactured Part Variation Modelling:** Developed a morphing-Gaussian Random Field methodology to model and simulate part form error during early design phase and enable accurate simulation of an assembly process.

IIT-Kharagpur — India
Graduate Research Assistant — *July 2013 – June 2014*

- **Decision Support System for Material Handling:** Developed a decision support system to optimally automate day to day decision making regarding stockyard maintenance and rake loading, for Dhamra Port Corporation Ltd., India.

Aeronautical Development Agency (ADA), DRDO — India
Junior Research Fellow — *Apr 2012 - July 2012*
Responsible for the aerodynamic aspects of the Multidisciplinary Design Optimization (MDO) of a transport class aircraft during its design phase and developed a MDO framework to handle the aircraft stability and aerodynamic interactions for the aircraft.

- **Systems Engineering:** Created a systems engineering framework for the conceptual design of a transport class aircraft.

- ○ **Multi-Disciplinary Optimisation (MDO):** In-charge of Aerodynamic aspects of MDO of a transport aircraft using modeFrontier software.
- ○ **CAD Modelling:** Designed aircraft wing using CATIA design software.

- **Aeronautical Development Establishment (ADE), DRDO** India
  Project Contract Engineer *Apr 2011 - Mar 2012*
  Involved in conceptual and preliminary design, aerodynamic analysis of Unmanned Air Vehicle (UAV), which resulted in a 2.3 kilogram autonomous Mini-UAV with an endurance of 2.5 hours.
  - ○ **Conceptual and Aerodynamic Design:** Designed a 2.3 kilogram autonomous Unmanned Air Vehicle (UAV) with an endurance of 2.5 hours.
  - ○ **Aerodynamic and Stability Analysis:** Estimated aerodynamic drag of the UAV using engineering methods. Analysed flight data for characterization of take-off, landing, climb and turn performance of the UAV.
  - ○ **Mechanical Design:** Meshed and analysed wing alone configuration of the UAV.

Software and Programming Skills

Scripting	: Matlab, Python, C++	**CAD**	: CATIA, Solidworks
Robot programming	: Robot Studio	**3D Scanner**	: CoreView Teach
CoP manipulation	: Geomagic Wrap	**Statistical software**	: Minitab
Mesh manipulation	: Hypermesh	**Version Control**	: Git
Other Tools	: MS-Office, LaTeX		

Hardware Certifications

- **ABB:** Industrial robot (IRB:6620-150) programming and operation.
- **Hexagon:** White Light Scanner (WLS400A) measurement solution programming and operation.

Academic Achievements

- **WMG Scholarship:** Awarded full scholarship to pursue PhD at WMG, University of Warwick.
- **GATE Score:** Secured 94.9 percentile in national Graduate Aptitude Test in Engineering (GATE) examination.
- **MHRD Scholarship:** Awarded Ministry of Human Resource Development (MHRD), Government of India, scholarship to pursue M.Tech at IIT Kharagpur.
- **Shri R Venkataraman Prize:** Awarded for best overall performance in associate membership examination of the Aeronautical Society of India.
- **All India Ranks:** Have secured top ranks in various subjects in associate membership examination of the Aeronautical Society of India.

Publications

- **Babu, M.**, Franciosa, P., & Ceglarek, D. (2019-Accepted). Spatio-temporal adaptive sampling for effective coverage measurement planning during quality inspection of free form surfaces using robotic 3d optical scanner. *Journal of Manufacturing Systems*.
- Pratap, S., **Kumar, M.**, Saxena, D., & Tiwari, M. K. (2016). Integrated scheduling of rake and stockyard management with ship berthing: A block based evolutionary algorithm. *International Journal of Production Research*, *54*(14), 4182–4204. doi: 10.1080/00207543.2015.1111535
- **Babu, M.**, Franciosa, P., & Ceglarek, D. (2018). Shape error modelling and analysis by conditional simulations of gaussian random fields for compliant non-ideal sheet metal parts. *Procedia CIRP*, *75*, 279–284. doi: 10.1016/j.procir.2018.04.023
- **Babu, M.**, Franciosa, P., & Ceglarek, D. (2017). Adaptive measurement and modelling methodology for in-line 3d surface metrology scanners. *Procedia CIRP*, *60*, 26. doi: 10.1016/j.procir.2017.01.009
- Pratap, S., **Kumar, M.**, Cheikhrouhou, N., & Tiwari, M. K. (2015). The robust quay crane allocation for a discrete bulk material handling port. *2015 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, 1174–1178.