An Open Data Network for Manufacturing

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Blue Sky Competition
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**Blue Sky Vision**

**Experimental data:** key requirement in advancing manufacturing process development and modeling!

- Model calibration and validation
- Fundamental analysis of a process
- Process development
- Material characterization
- Stability lobe diagram in milling

**Current state for experimental data:**
- cannot be shared and accessed easily
- available data not consolidated

**Blue Sky Vision:** community data sharing through an open data network for manufacturing!
Need

Consider a user interested in process parameters and tool life in turning Inconel 718:
Consider a user interested in process parameters and tool life in turning Inconel 718:
Need

Consider a user interested in process parameters and tool life in turning Inconel 718:
Need

PCBN insert, depth of cut – 0.2 mm, max. flank wear – 300 µm, notch wear – 600 µm
Raw data not published - 27 experiments

Kennametal PVD coated grade, max. wear (flank, notch) – 300 µm, crater wear – 100 µm

- Rest of the papers:
  - focus on surface roughness – tool wear information not reported
  - raw data not reported

CVD coated insert, feed – 0.1 mm/rev, depth – 0.5 mm
90 mm cut length – need to calculate cut time
Need

Consider a user interested in surface potential and surface finish relation for ECM of Inconel 718:

About 57,700 results (0.67 seconds)

Did you mean: inconel 718 ECU potential for good surface finish

Dissolution Effects with Different Microstructures of Inconel 718 ... jesi.ecsd.org/content/165/15/EB72.full
by D Zhu - 2018 - Related articles
Dec 19, 2018 - Inconel 718, a high-strength, thermal-resistant, nickel-based alloy, is widely used in the aviation field. ... ECM offers a better and more economical alternative for generating complex-shaped components from Inconel 718. A large amount of research on dissolution characteristics has been carried out in ECM.
You've visited this page 2 times. Last visit: 5/22/19

(PDF) Dissolution Effects with Different Microstructures of Inconel 718 ... https://www.researchgate.net/.../329789430_Dissolution_Effects_with_Different_Micros...
Jan 2, 2019 - the anodic dissolution behavior and surface texture development of cobalt under ECM ... led the ECM property of two laser rapid formed Inconel 718 alloys ... electrode potential are the first to undergo a chemical reaction in ECM. ... the surface quality is better when the content of Nb in Inconel 718 is low.
You visited this page on 5/20/19.

by D. Wang - 2019 - Cited by 1 - Related articles
Feb 18, 2019 - The surface roughness of the non-machined area can be noticeably improved. ... Electrochemical machining (ECM) is an anodic dissolution process, ... The potential ranges from ~2 V to 2 V with a scan rate of 1 mVs.
You visited this page on 5/20/19.

Multiple performance optimization of electrochemical drilling of Inconel ... https://www.sciencedirect.com/science/article/pii/S221509861630554X
by N Manikandan - 2017 - Cited by 13 - Related articles
Besides the material removal rate and surface roughness, the geometric measures such as ... Superalloys Inconel 625 are extensively utilized in numerous engineering ... Electrochemical Machining (ECM) is one of the contemporary machining ... voltage applied, discharge rate of electrolyte in determining the best possible ...
Table II. Experimental conditions.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode feeding rate ( v_c ) (mm/min)</td>
<td>0.5</td>
</tr>
<tr>
<td>Electrolyte</td>
<td>NaNO₃</td>
</tr>
<tr>
<td>Inlet pressure ( P_i ) (Mpa)</td>
<td>0.8</td>
</tr>
<tr>
<td>Outlet pressure ( P_o ) (Mpa)</td>
<td>0.15</td>
</tr>
<tr>
<td>Electrolyte temperature ( T ) (°C)</td>
<td>30±0.5</td>
</tr>
<tr>
<td>Electrolyte conductivity ( \kappa ) (Ω⁻¹m⁻¹)</td>
<td>15.2</td>
</tr>
<tr>
<td>Electrolyte concentration</td>
<td>20%</td>
</tr>
<tr>
<td>Voltage ( U ) (V)</td>
<td>20</td>
</tr>
<tr>
<td>Pulse duty</td>
<td>70%</td>
</tr>
<tr>
<td>Pulse frequency ( f ) (Hz)</td>
<td>1000</td>
</tr>
<tr>
<td>Initial inter-electrode gap (mm)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Solid-solution material: Ra 1.378 μm
Solution and aging material: Ra 0.188 μm
One test condition given

Rest of the papers:
- don’t report surface roughness
- raw data not reported
- focus on various surface artifacts without providing adequate experimental details
Need

Available experimental data mostly from journal and conference papers -

- raw data not published
- data only relevant to study in question reported
- experimental data that does not validate the proposed model does not get published – underlying data may be valid
- experimental validation with small datasets cannot be extrapolated

How can we improve experimental data reporting and consolidate results?
Vision

An open data network for manufacturing processes to compile all manufacturing process experimental data!

Online search → Google www.google.com

Manufacturing process data → MDN www.mfgdatanetwork.com
Introduction:
The manufacturing data network is a collaborative effort between academia, government labs, and industry to serve as a data source for all manufacturing process data.

Download:
Standard data templates for processes:
- Turning
- ECM
- Additive – Powder Bed Fusion
- Milling
- EDM
- Additive – Binder Jet
- Drilling
- Laser
- Additive - DED
- Grinding
- Welding

Data summary:
- 700 contributors
- 17 processes
- 410K data points
- 26K downloads
<table>
<thead>
<tr>
<th>#</th>
<th>Machine</th>
<th>Tool</th>
<th>Type of cut</th>
<th>Cut speed (s/min)</th>
<th>Coolant</th>
<th>Cut time (min)</th>
<th>Tool wear (mm)</th>
<th>Type of wear</th>
<th>Surface roughness</th>
<th>Tool Images</th>
<th>Source</th>
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<td>0.18</td>
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<td>0.27</td>
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<td>-</td>
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<td>-</td>
<td>[Image]</td>
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</table>
Blue Sky questions:

- Can a standardized data template be created for each process?
  - ‘must have’ and ‘nice to have’ inputs?
- How can the data be curated effectively?
- How do we ensure data quality?
Blue Sky questions:

- What are the right incentives to contribute to the network?
  - data analytics and visualization toolkit
  - requirement for journal submission
Vision

Blue sky questions:

• How do we facilitate and encourage collaboration between researchers?
  o manufacturing & data science

• What role does industry participants play in the network?
  o validate data with shop experience

• How do we create a user community to fill-in experimental data gaps?
Blue sky questions:

• How do we share learnings from the data widely with the community?
• How can teachers use the data to enhance manufacturing learning and outreach?
  o sample datasets for variables
  o demonstration videos
Blue sky questions:

• How to ensure effective management and support of the data network?
  o process and data owners
  o data storage and site maintenance
Vision

Research + Education:

• Intersection of multiple disciplines - manufacturing science, computer science, and data science

• Accelerate advances in manufacturing process development and modeling through collaboration and community learning

• Facilitate innovation in machines and tools by benchmarking best-in-class

• Enhance manufacturing education and outreach;
  • real world data
  • up-to-date with current state of the art
Thank you!