ICAF

International Committee on Aeronautical Fatigue and Structural Integrity

Fatigue Crack Growth and Life Prediction Methods II

Simon Barter[1] and Ben Main[2] | 10 June 2025

[1] RMIT University, [2] Defence Science and Technology Group

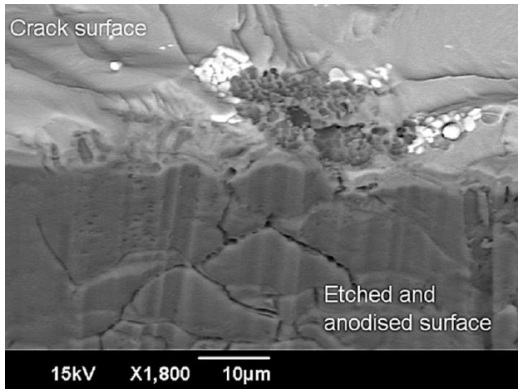
Overview

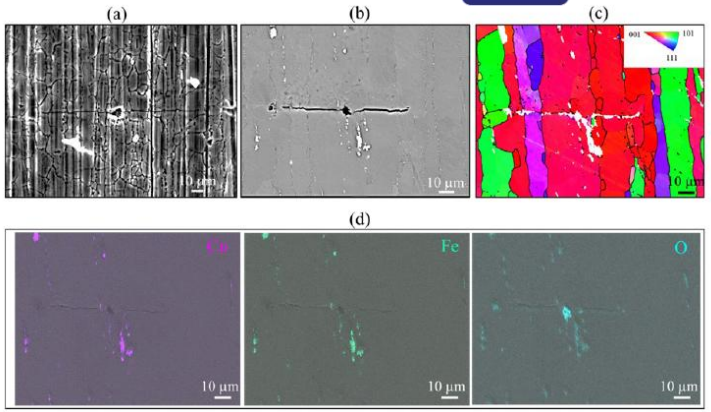
- A brief summary of fatigue crack growth and life prediction methods research reported in the ICAF 2025 National Reviews of:
  - Australia
  - Brazil
  - Canada
  - Israel
  - Japan

- The authors acknowledge the National Delegates from these countries:

Equivalent Initial Damage Size (EI..)

- EIDS research with an anodised AA 7085 f



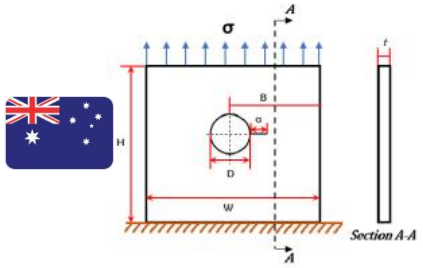


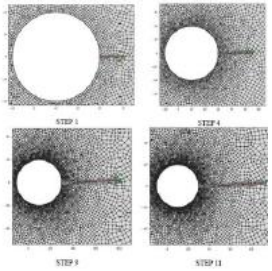
- EIDS / EPS in AA 2C

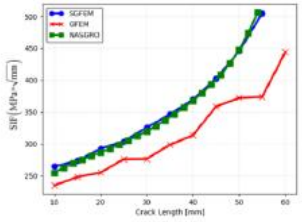
- B. Dixon, B. Main and S. Barter, 'Equivalent initial damage size (EIDS) for Type 1C anodised aluminium alloy 7085-T7452 under variable amplitude loading', *Engineering Failure Analysis*, 2023. https://doi.org/10.1016/j.engfailanal.2023.107578
- B. Main, L. Jiang, R. Marceau and S. Barter, 'Material characterization of anodising effects on small fatigue crack nucleation in AA 7XXX alloys', *Materialia*, vol. 33, 2024. https://doi.org/10.1016/j.mtla.2023
- L. Molent and M. R. Fox, 'Crack-like effectiveness of some discontinuities in AA2024', *Fatigue and Fractures of Engineering Materials and Structures*, September 2023. https://doi.org/10.1111/ffe.14145

Fatigue crack growth (FCG) mode..

- Optimised FCG mode
- Models for FCG with spike overloads
- 'Simple scaling' closur e near-threshold FCGR models
- Stable generalised FEMs of FCG



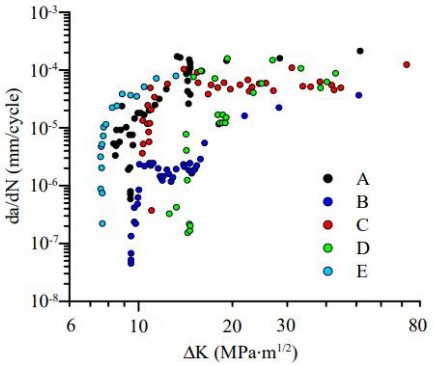


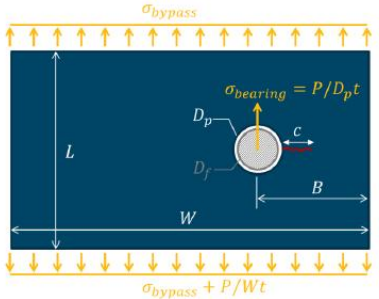


- B. Dixon, H. Fayek, C. Hodgen, T. Wiley and S. Barter, 'Optimising fatigue crack growth predictions for small cracks under variable amplitude loading', *International Journal of Fatigue*, vol. 184, 2024. https://doi.org/10.1016/j.ijfatigue.2024.108339
- K. F. Walker, A. Grice, J. C. Newman Jr., R. Zouev, S. A. Barter and D. Russell, 'Simulation of fatigue crack growth in aluminium alloy 7050-T7351 under spike overload and aircraft spectrum loading', *International Journal of Fatigue*, vol. 190, January 2025. https://doi.org/10.1016/j.ijfatigue.2024.108660
- Felipe L. Lopes, Rafael M. Lins, Mariano A. Arbelo, . Crack propagation analysis due to fatigue using the Stable Generalized Finite Element Method (SGFEM), presented in XLV The XLV Ibero-Latin American Congress on Computational Methods in Engineering –(CILAMCE 2024), Maceió, Brazil, November 2024

Fatigue crack growth (FCG) mode…

- Data-driven machine learning predictions of FCGRs in AA7…
- Development of stress intensity factor (SIF) solutions for filled and interference fit f…er holes
- Crack interaction effects semi-elliptical surface with adjacent corner crack
- Mode I & II SIF for edge-cra… affected by adjacent horizontal cracking



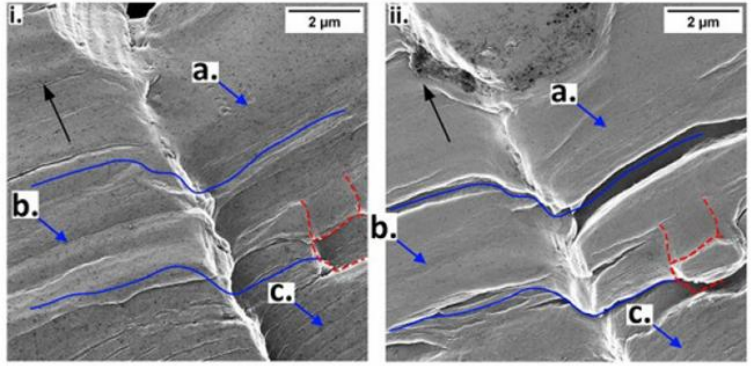


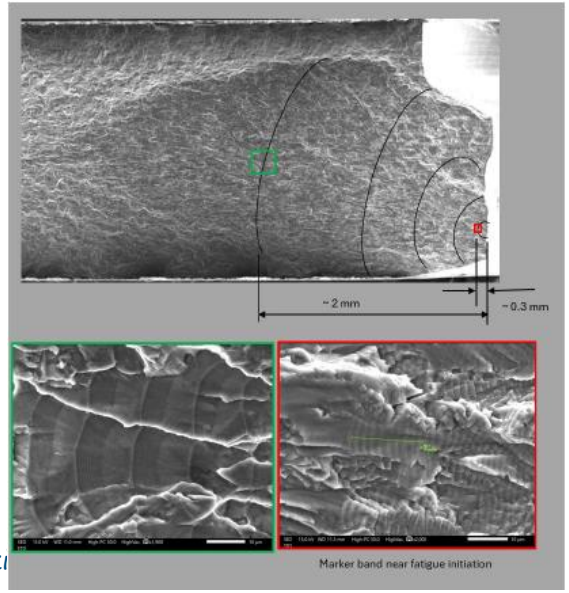
W: Plate width
B: Hole edge distance
D_p: Hole diameter
E_p: Plate elastic modulus
ν_p: Plate Poisson's ratio
D_f: Fastener diameter
E_f: Fastener elastic modulus
ν_f: Fastener Poisson's ratio
c: Crack length
σ_{bypass}: Remote bypass stress
$\sigma_{bearing}$: Bearing stress
P: Bearing load
$\delta = (D_f - D_p)/D_p$: Interference level

- Y. Freed, 'Machine learning based predictions of crack growth rates in an aeronautical aluminium alloy', *Theoretical and Applied Fracture Mechanics*, vol. 130, April 2024. https://doi.org/10.1016/j.tafmec.2024.104278
- Q. Ma, C. Levy, and M. Perl, 'The Change in the SIF of an Internal Semi-Elliptical Surface Crack Due to the Presence of an Adjacent Nonaligned Corner Quarter-Circle Crack in a Semi-Infinite Plate Under Remote Bending', In: Pressure Vessels and Piping Conference, ASME, July 2023. https://doi.org/10.1115/PVP2023-105374
- C. Levy, M. Perl, and Q. Ma, 'Mode I and Mode II Stress Intensity Factors for a Slanted-Edge-Crack Affected by an Adjacent Horizontal Crack Under Remote Tension', In: Pressure Vessels and Piping Conference, ASME, July 2024.

Experimental FCG studies

- FCG in mono/poly crystals of Ni
- Fractographic studies of mating fracture surface tures
- Development of marker bands for different da rates
- Effect of thermal and external load on mechanical behaviour of CFRP/Alun m hybrid joints





- A. Petel, A. Jager, D. Babai, J. Jopp, A. Bussiba, M. Perl, and R. Z. Shneck, 'Fatigue Crack Growth in a Monocrystal and Its Similarity to Short-Crack Propagation in a Polycrystal of Nickel', *Metals* vol. 13, 2023. https://doi.org/10.3390/met13040790
- I. Field, E. Kandare, B. Dixon and S. Barter, 'An analysis of fatigue crack growth features at various crack lengths through mating fracture surface pairs', *Fatigue and Fractures of Engineering Materials and Structures*, 2024. https://doi.org/10.1111/ffe.14276
- T. Okada, H. Kumazawa, T. Toyosawa, T. Takeda, T. Kasahara, K. Yamada, K. Nagao, Y. Aoki and H. Shoji, Research for thermal load and procedure to predict fatigue life up to form a fatigue crack on CFRP/Aluminum hybrid joints, proceedings of the 31st ICAF symposium, Delft, 2023

FCG in Additive Manufacturing (A…)

- Predicting the FCG of Small Cracks in Wire Arc Additively Manufactured (WA…) Titanium
- Enhancing the Fatigue Performance of AM Components with Minimal Inter…ion
- On the FCG of Small Cracks in 2024-T3 and Boeing Space, Intelligence and Weapon Systems AM LP…Scamalloy
- Transfer Learning for Fractographic Analysis in

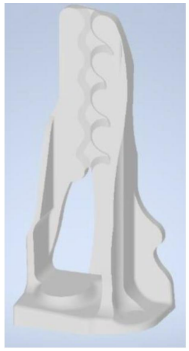
- R. Jones, A. Ang, R. W. Aston, N. D. Schoenborn, V. K. Champagne, D. Peng and N. D. Phan, 'On the growth of small cracks in 2024-T3 and Boeing Space, Intelligence and Weapon Systems AM LPBF Scamalloy', Fatigue and Fractures of Engineering Materials and Structures, vol. 48, pp. 31-43, September 2024. https://doi.org/10.1111/ffe.14468
- A. Ang, R. W. Aston, H. King, S. S. L. Chan, N. D. Schoenborn, D. Peng and R. Jones, 'Corrosion and Fatigue Behaviour of Boeing Space, Intelligence and Weapons Systems Laser Powder Fusion Built Scalmalloy in 5% NaCl', Fatigue and Fracture of Engineering Materials and Structures, February 2025. https://doi.org/10.1111/ffe.14601
- Or Haim Anidjar, Ro'i Lang, and Mor Mega, 'Transfer learning methods for fractographic detection of fatigue crack initiation in additive manufacturing', IEEE Access, vol. 12, pp. 6262–6280, 2024.

FCG in Additive Manufacturing (A.. .,

- Advancements in Certifying AM Primary Structural Components for Aerospace
- Effect of temperature on tensile and fatigue performance of AM AlSi10Mg lattice structu

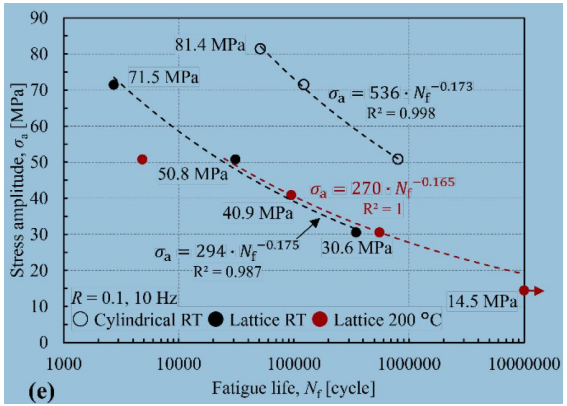
EWB

OEM AA



LPBW

(c)



Wang, Z., Wu, W., Qian, G., Sun, L., Li, X., Correia, JAFO., 2019. In-situ SEM investigation on fatigue behaviors of additive manufactured Al-Si10-Mg alloy at elevated temperature. Engineering Fracture Mechanics 214, 149–163.

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Questions

Australian Government
Department of Defence
Defence Science and Technology Group

RMIT UNIVERSITY