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A Machine Learning Algorithm for Analysis of Connective Tissue Networks in Scarring and Chronic Fibroses

The Longaker lab at Stanford University has developed a machine learning algorithm that can analyze and detect fibrotic disease. This software can make clinical identification and assessment of fibrotic diseases more precise, potentially leading to improved patient outcomes.

Fibrosis represents a major cause of morbidity worldwide and can involve a wide variety of organs and tissues. It is estimated that 45% of deaths in the United States are attributable to major-organ fibrosis (e.g., myocardial infarct, stroke, liver cirrhosis), fibroproliferative disorders (e.g., scleroderma, myelofibrosis), and scarring associated with trauma. Clinicians and pathologists diagnose and stage these diseases using visual observation, leaving room for physician bias and the inability to capture subtle clinical progression. The Longaker lab has developed a machine learning algorithm that can digitally analyze and classify patient samples. This approach is highly sensitive and can avoid biases inherent with human observation. In addition, it can more accurately track and recognize changes in disease progression. The algorithm identifies a variety of properties relevant to fibrosis, including the appearance of extracellular matrix fibers and branchpoints, and fiber length and width. This technology has the potential to greatly improve patient outcomes and streamline disease classification and tracking.

Applications

- Pathological and clinical assessment of fibroses, including: scarring, systemic sclerosis, myelofibrosis, and cirrhosis

- Early identification of fibrotic diseases
- Precise, objective quantification of fibrotic diseases

Advantages

- Removes physician bias in diagnosis and staging of disease
- Rapid quantification and scoring of fibrotic samples
- Can capture the spatial and morphological complexity of the disease in question

Publications

- Chinta M, Mascharak S, Borrelli MR, et al. **(2019)** "Machine Learning Analysis Of Connective Tissue Networks Enables Objective Characterization Of Skin Fibroses." *Plast Reconstr Surg Glob Open*. 7, 27-28.
- Shamik Mascharak et al. **(2021)** Preventing Engrailed-1 activation in fibroblasts yields wound regeneration without scarring. *Science* 372, eaba2374.
- Mascharak S, Talbott HE, Januszyk M, Griffin M, Chen K, Davitt MF, Demeter J, Henn D, Bonham CA, Foster DS, Mooney N, Cheng R, Jackson PK, Wan DC, Gurtner GC, Longaker MT **(2022)**. Multi-omic analysis reveals divergent molecular events in scarring and regenerative wound healing. *Cell Stem Cell*. 2022 Feb 3;29(2):315-327.e6. Epub 2022 Jan 24. PMID: 35077667; PMCID: PMC8988390.
- Mascharak S, Guo JL, Foster DS, Khan A, Davitt MF, Nguyen AT, Burcham AR, Chinta MS, Guardino NJ, Griffin M, Lopez DM, Miller E, Januszyk M, Raghavan SS, Longacre TA, Delitto DJ, Norton JA, Longaker MT **(2023)**. Desmoplastic stromal signatures predict patient outcomes in pancreatic ductal adenocarcinoma. *Cell Rep Med*. 2023 Nov 21;4(11):101248. Epub 2023 Oct 20. PMID: 37865092; PMCID: PMC10694604.

Patents

- Published Application: WO2021021720
- Published Application: 20220261996
- Issued: 12,236,599 (USA)

Innovators

- Shamik Mascharak
- Heather Talbott
- Mimi Borrelli
- Alessandra Moore
- Michael Longaker

Licensing Contact

Inyoung Lee

Licensing Manager, Life Sciences

Email