Machine Vision-Based System and Methods for Wound Diagnostics and Therapies

Tech ID: 34018 / UC Case 2024-818-0

BACKGROUND

Precise control of wound healing depends on physician's evaluation, experience. Physicians provide conditions and time for body to either heal itself, or to accept and heal around direct transplantations, and their practice relies a lot on passive recovery. Slow healing of recalcitrant wounds is a known persistent problem, with incomplete healing, scarring, and abnormal tissue regeneration. 23% of military blast and burn wounds do not close, affecting a patient's bone, skin, nerves. 64% of military trauma have abnormal bone growth into soft tissue. While newer static approaches have demonstrated enhanced growth of non-regenerative tissue, they do not adapt to the changing state of wound, thus resulting in limited efficacy.

TECHNOLOGY DESCRIPTION

To overcome these challenges, a research team at UC Santa Cruz (UCSC) has developed a more intelligent system and related devices and methods to control tissue regeneration towards better wound healing processes. UCSC's Bioelectronics for Tissue Regeneration (BETR) aims to establish bidirectional communication between body and a bioelectronic interface that will guide and expedite tissue healing and regeneration. BETR's dynamic, adaptive closed-loop architecture guides tissue along an optimal growth pathway. The custom hardware uses wearable biochemical and biophysical sensors to precisely determine current and wound states and actuators to deliver biochemical and biophysical interventions at relevant time points. Custom optics, software, and supporting logic is the adaptive learning system that connects camera, sensors, and actuators for optimal and directed temporal and spatial response. BETR's evolving aims include the detection of predictive biomarkers to better assess healing and non-healing wound states, which factors into data-driven, closed-loop feedback controls.

This subject matter is centered on machine vision-based system and methods for BETR wound diagnostics and treatments, with a focus on transcriptomics and oscillatory behavior of non-healing wounds. Wound healing involves a careful coordination among various cell types carrying out unique or even multifaceted functions. The abstraction of this complex dynamic process into four primary wound stages has been instrumental in generating early insights into tracking wound progression, including universal characteristics of gene expression in wound healing stages. UCSC's preliminary research results demonstrate a novel paradigm for understanding wound chronicity and show early promise in new data- and time-driven intervention(s). Therapies delivered at the right dose at the right time, using the healing stage/state as critical parameters and feedback, may meaningfully increase the rate of healing of a treatment site and/or enable a healing state that converges to a desired healing state.

APPLICATIONS

- diagnostics – wound healing
- therapeutics – wound healing

FEATURES/BENEFITS

- adaptive and data-driven; robustly identifies dominant wound healing stage
- multi-clustering approach based on temporal gene expression dynamics
- uses custom algorithms for understanding wound healing progression toward effective closed-loop controls
- may reduce healing variability in non-healing wounds

INTELLECTUAL PROPERTY INFORMATION

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OTHER INFORMATION

KEYWORDS

bioelectronics, bioelectronic bandage, wound, wound healing, wound stage classification, transcriptomics, time-series expression, bandage, smart bandage, chronic wounds, dermal, skin, dressing, macrophage, macrophages

CATEGORIZED AS

- **Medical**
  - Delivery Systems
  - Devices
  - Diagnostics
  - Disease: Dermatology
  - Therapeutics
- **Sensors & Instrumentation**
  - Medical

RELATED CASES

2024-818-0

Patent Pending

RELATED MATERIALS

- Zlobina, Ksenia, et al. "Robust classification of wound healing stages in both mice and humans for acute and burn wounds based on transcriptomic data." BMC bioinformatics. 2023 Apr 25;24(1):166.

RELATED TECHNOLOGIES

- Wearable Bioelectronics for Programmable Delivery of Therapy

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