T.A.C.S.
Thermo Acoustic Cell Sorter
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Overview

- Client
- Budget
- TACS System Diagram
- Objective
- Functional Parts of the TACS
  - Device Flow
  - Electronics
  - Materials
- Conclusion
Cell Stock Holder
Laser Diode/ PVDF Membrane apparatus
Capillary Tube
Actuating Material/Gate Mechanism
Sorted Cell Bins
Client

- Dr. Shiva Kotha
  - UConn Professor
  - BME/ME
  - Biomechanics, Rehabilitation Engineering & Ergonomics
  - Bronwell 204
Budget

- Agreed on $5000
- Research will require several prototypes
- Ordering to begin immediately

- First Items:
  - Capillary Tubing
  - PVDF membranes
  - Conductive epoxy
Project Purpose

- Allow Dr. Kotha to further his research
- Use different scientific methods of cell sorting
- Device Size
- Future uses of the T.A.C.S.
Previous Work in Cell Sorting

- Invitrogen

- Flow Cytometry
  - Light based
  - Large Size
  - High Cellular flow rate
Why is T.A.C.S Special?

- T.A.C.S. incorporates the thermo acoustic theory to achieve the same goals as currently used cell sorters
  - Ultrasonic waves detected by PVDF membranes
  - Actuating Material to direct the flow of the sorted cells using a voltage
  - Smaller size allowing for multiple uses
Overview of System

- New cell enters capillary tube
- Cell enervation by the laser diode
- Cell expansion and contraction releases ultrasonic wave
- Cell type determination and gate actuation
- Voltage response by PVDF film
- Cell flows through gate a and into bin a
- Cell flows through gate b and into bin b
Cellular Flow

- Saline bags will be used to hold the cell stock
- Capillary tubes will be attached to the ends of the bags
- Sorted bins will allow for maximum flow of the stock if only one type of cell is present
Flow Devices

- Hydrodynamic focusing will potentially be used to control the rate of flow
- This device allows for single-file cellular flow
Capillary Tubing

- Borosilicate glass–Boron infused silica
- Low thermal expansion
- High transmittance of light
Electronic System

Consists of:
- Laser Diode
- PVDF Sensors
- Analog Filters
- Operational Amplifiers
- Data Acquisition (National Instruments)
- Software Program
- Actuating Gates
Laser Diode

- A 670 nm Laser Diode
- Inexpensive
- Trypan blue dye absorbs all wavelengths of light above 500 nm
PVDF Film – Polyvinylidene Fluoride

- Piezoelectric when poled
  - Generates a voltage when the shape changes and vice versa
- Commonly used as ultrasonic sensors
- Different thicknesses respond to different frequency ranges
- Challenges
  - Cannot be soldered
  - Must adhere to the micro channel
Analog Filters

- Analog filters will only be used if necessary
- Likely filters to be used
  - Notch filter with cutoff frequency of 60Hz
  - High pass filter to remove interference from vibrations in the surrounding environment especially sound.
Operational Amplifier

- Strengthens signal
- Prevents damage to the data acquisition device
- Connect the analog output to the actuating gate
Data Acquisition – NI USB-6009

- 8 Analog inputs (+− 10v)
- Sampling Frequency of 48Khz
- 2 Analog outputs (0−5v)
- Compatible with LabVIEW
- Relatively inexpensive ($279)
Software System

Consists of:

◦ Digital Filtering
◦ Feature Extraction
  • Quantitatively identify important information within the signal to help in differentiating between cell types
◦ Classification
  • Artificial Neural Network
  • Simplifies Classification
  • Supervised Machine Learning (Back-propagation algorithm)
Actuating Gate

- Charged Zeolite crystal
- Absorb ions upon electrical stimulation
- Increases in volume
- Selectively blocks and changes flow
Questions

- Are there any?
In Case You Ask about Artificial Neural Networks