



# ViBES: A Tool for Parametric Evaluation of *in vitro* Cell Guidance



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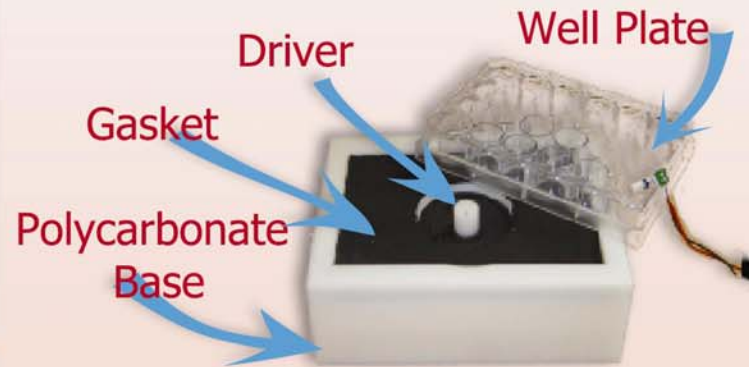
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## Abstract

- Polymers can act as scaffolds to support tissue repair at the wound site
- Some biocompatible polymers, such as Poly(L-lactic acid) (PLLA) and Poly(vinylidene fluoride) (PVDF) can be rendered piezoelectrically active (PZ)
- We have developed **ViBES**: activates PZ effect on these polymer films by mechanical vibration
- PZ effect may enhance cell growth *in vitro*

## ViBES: Vibration Base for External Stimulation of Cell Cultures



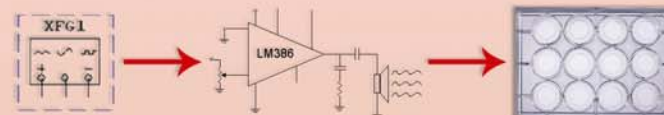
- Polycarbonate housing holds standard well plate
- Driver provides mechanical stimulation to activate the PZ effect
- Designed to fit within an incubator
- Platform insulates cell culture from external vibrations

## Control System

Allows for cell cultures to be stimulated at a spectrum of frequencies and amplitudes.

- housed within ViBES base
- enhance the driving ability
- optimize user interface

Control paradigm: Func. Gen. → External Modulatory Device



1. Signal programmed in the MATLAB Signal Processing Toolbox
2. Low Voltage Audio Amplifier transmits signal to ViBES

## Characterization of Polymers

Stimulation parameters examined to determine optimal conditions for aligned cell growth

PLLA 20 Hz	PZ-Active PLLA 20 Hz	PVDF 20 Hz	PZ-Active PVDF 20 Hz
PLLA 80 Hz	PZ-Active PLLA 80 Hz	PVDF 80 Hz	PZ-Active PVDF 80 Hz

Table: Experimental matrix for *in vitro* experimentation

- Different polymers examined to determine PZ effect on cell growth
- We have devised algorithms for cell feature extraction from fluorescent images:

1. Size
2. Alignment
3. Displacement
4. Growth
5. Migration Velocity
6. Eccentricity

## References

- Schmidt, C., Leach, J., (2003) "Neural Tissue Engineering: Strategies for Repair and Regeneration" *Annu. Rev. Biomed. Eng.* **5**:293-347.
- Zhao, M., Forrester, J., McCaig, C., (1999) "A small, physiological electric field orients cell division" *Proc. Natl. Acad. Sci.* **96**:4942-6.

## Conclusions

- ViBES developed to stimulate cultured cells
- Control System will generate continuous sine waves
- Cells stimulated at specified frequencies
- Polymers evaluated to determine optimal conditions for aligned cell growth

## Preliminary Work

**ViBES:** Rat dermal Fibroblasts  
 PLLA & PZ-active PLLA (PZLA)  
 72 hours incubation  
 50 Hz sinusoidal stimulation

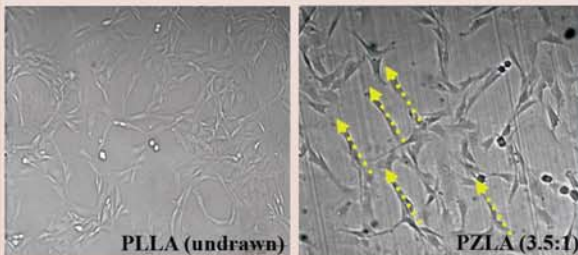


Figure: Cells seeded on undrawn PLLA (left); fibroblasts seeded onto PZ-active PLLA (PZLA) drawn to 3.5:1 (right)

**PZLA & PLLA**

**PZLA Condition**

- Similar Morphology ↑ Alignment (~30° to draw)
- ↑ Outgrowth at 72 hours