

Exceptional service in the national interest



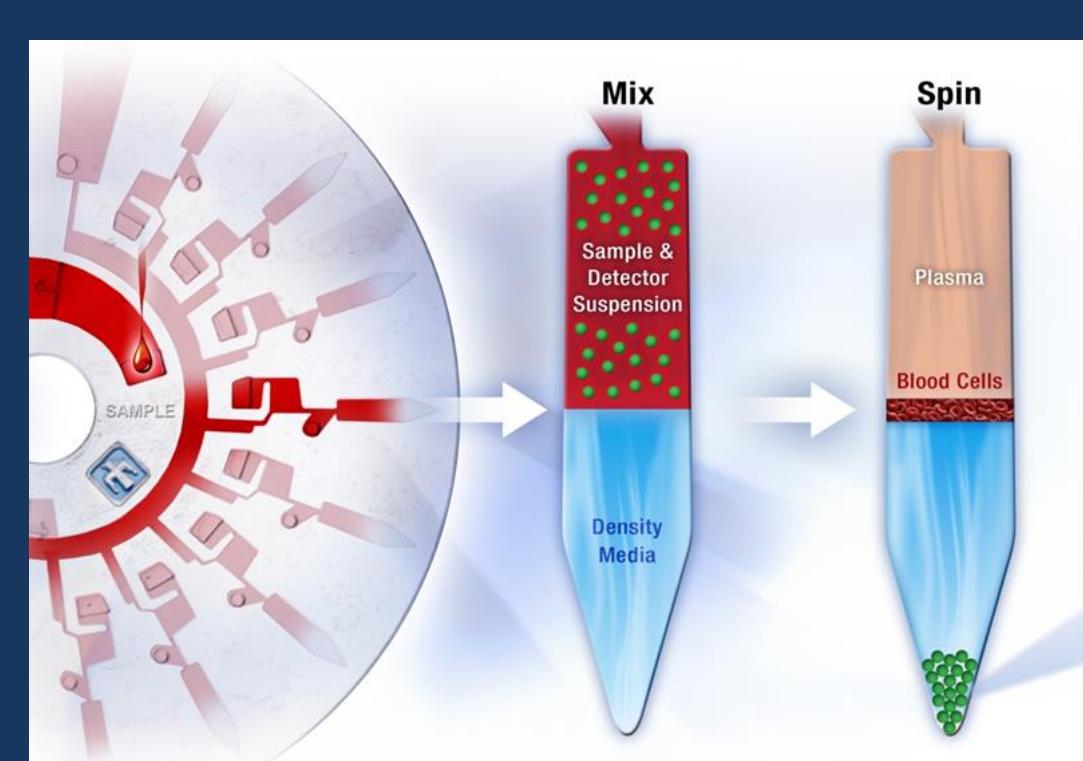
Reliability Testing and Android Development for a Centrifugal Microfluidic Diagnostic Platform

John Giblin, Georgia Institute of Technology, B.S. Biomedical Engineering, est. May 2017

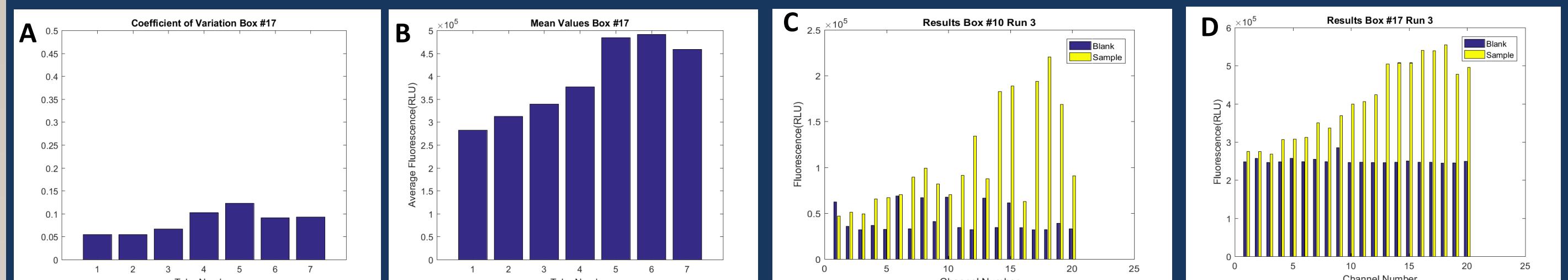
Chung-Yan Koh Biotechnology and Bioengineering Department, Org. 0821

Abstract:

Twenty SpinDx prototypes were assembled on site and tested for their reliability and consistency. Each device analyzed 10 sets of an IL-6 immunoassay prepared at 7 preset concentrations. Coefficient of variation was used as a measure of the device's ability to produce similar results from the same assay. Results showed little to no user dependence but overall reliability suffered likely due to well misalignment during sample reading. The current version of SpinDx relies on a PC to control the device and collect data for analysis. The development of a standalone device would allow for increased portability and a simpler design. The development of an Android based application to run on the ODROID C2 device was made based on the source code from the desktop application. This not only allows for the potential of a standalone device, but allows the possibility for development of a mobile platform for all Android devices to communicate and control the SpinDx via Bluetooth



Results :



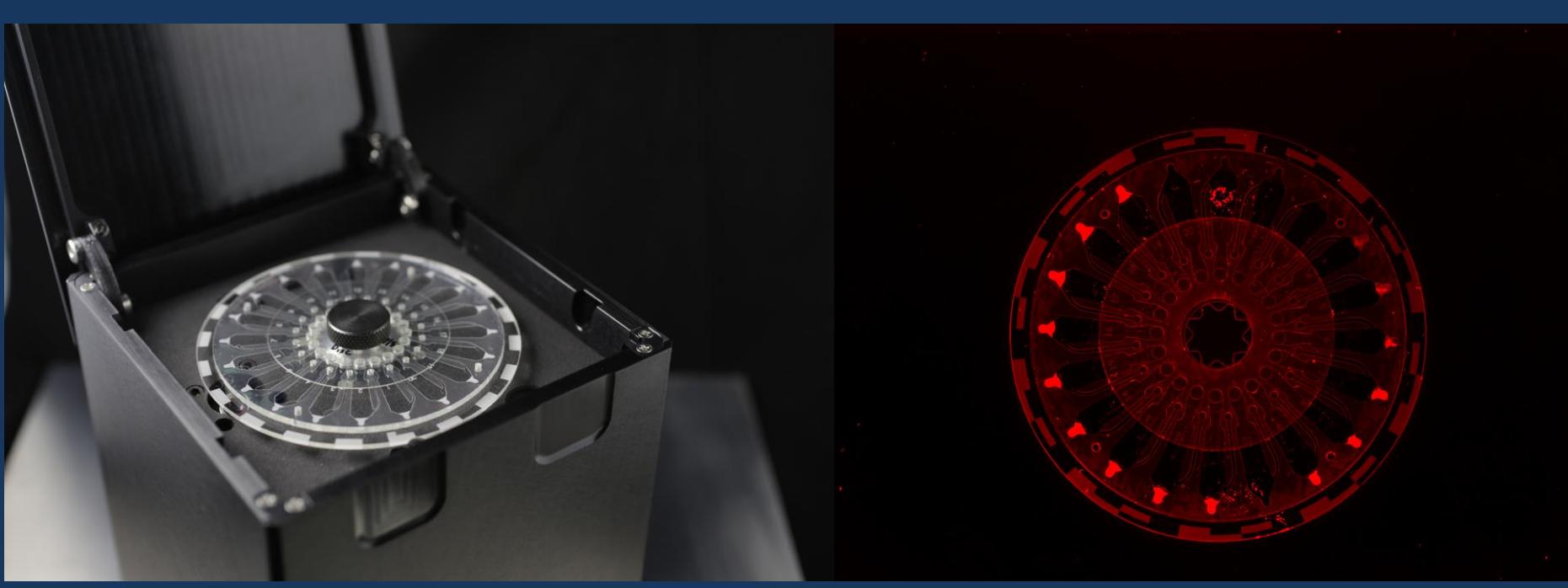
A) Coefficient of variation (σ/μ) of combined results from both users for each tube concentration (0-1000 ng/mL) B) Mean fluorescent values for each tube concentration demonstrating typical device results C) Results of an issue-free run D) Results where the run was affected by dead wells due to misalignment during sample reading

Discussion:

- Similar Coefficient of variation between two separate users shows results are not user dependent.
- Inter-device consistency will require PMT gain calibration to obtain consistent relative fluorescent values across different devices.
- “Dead” wells were the largest source of variation, likely caused by misalignment of laser during sample reading
- Device takes 20 samples across each well, misalignment means some samples are from empty disk space instead of the channel
- Failure of the channel to be aligned over laser focal point could be caused by servo imprecision or slippage

Introduction:

- SpinDx is a centrifugal microfluidics diagnostic device made to simultaneously run up to twenty different immunoassay samples
- Addresses the need for a reliable, mobile diagnostic device for infectious disease outbreaks and bioterrorism threats
- Portable device ideal for use in non-lab and constrained resource settings
- Battery powered, can be used up to a couple days in between charges
- Device is controlled from a desktop application via USB to microUSB connection



Methods:

- A serial dilution of IL-6 in PBS was prepared at concentrations of 1000, 300, 100, 30, 10, 3, and 0 ng/mL
- 5 μL were added to 15 μL of IL-6 antibody-laden capture beads and incubated at room temperature for 5 minutes
- 3.5 μL of 5 nM IL-6 detection antibody was added to each sample and incubated at room temperature in the dark for 20 minutes
- 3 samples of 5 μL were taken from each tube and placed into each channel of a disc, with density media pre-spun, in ascending concentration (1000 ng/mL was only given 2 wells)

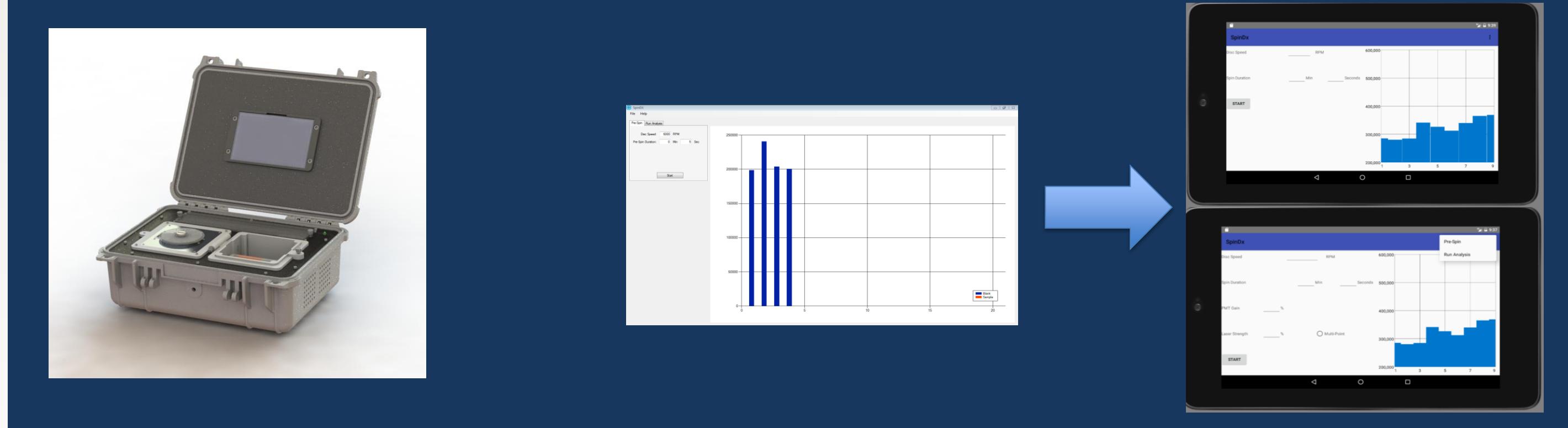
Android Development:

Advantages:

- Android devices are cheaper, more portable, and have a longer battery life for extended field work
- Test results can be sent wirelessly using both Wi-Fi and cellular data
- Flexibility in device used to operate SpinDx

Development:

- Modeled after the current version of the Windows software
- Made to be compatible with older versions of Android
- Designed to accommodate USB connection as well as Bluetooth for communication with SpinDx device
- LAMP capable prototype will use ODROID C2 device with touchscreen mounted inside the device casing



Acknowledgements:

Special thanks to Chung-Yan Koh, Christopher Phaneuf, Jonathan Ivers, and Sandia National Labs for their guidance and support. This work was supported by the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under Award Number R01AI098853. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.