Thermal Testing

Reference

Getting Started: http://support.flir.com/DocDownload/Assets/dl/t810200-en-us.pdf
User's Manual: http://support.flir.com/DocDownload/Assets/dl/t810252-en-us_usl.pdf
Tools: http://support.flir.com/tools
http://flir.custhelp.com/app/answers/detail/a_id/1568/kw/flir%20tools
http://support.flir.com/answers/A1568/FLIR%20Tools%20User%20Guide%20v2.1.1.pdf

Leia notes and powerpoint

Google Drive / LEIA_Engineering_Shared / Android Stuff / Thermal

Thermal Tests Setup

1. Hydrogen Phone setup
    a. Airplane Mode
    b. Set sleep to longest (30minutes)
        i. Settings / Display / Sleep / After 30minutes
    c. Turn off thermal engine

i. First need to download thermal-engine.conf to your computer
    1. https://drive.google.com/open?id=1fnNjhBp3iTi90Vh5tSPm8vid-SpwIMAL
    2. This comments out algo_type in GPU_management, LCD_management, LCD_3D_management
ii. In Terminal
    1. adb root
    2. adb remount #if failed, please run adb disable-verity, adb reboot
    3. adb push your_path/thermal-engine.conf /vendor/etc/thermal-engine.conf
    4. adb reboot
    5. adb root

d. Optional: Turn off USB charging (1 = off, 0 = on). Do this if you need to connect the USB between the phone and the PC to continue communication, but don't want additional heat from USB charging.
    i. In Terminal
        1. adb shell
        2. echo 1 > /sys/class/power_supply/battery/input_suspend
e. Optional: Change GPU frequency (for gaming)
    i. In Terminal
        1. adb shell
        2. cd /sys/class/kgsl/kgsl-3d0
        3. echo ___ > max_gpuclk
            a. 180000000 = min
            b. 710000000 = max

2. Collect temperature data over time
    a. FLIR camera
        i. Turn on FLIR camera
        ii. Start FLIR Tools on PC
        iii. Click Instruments
        iv. Click 'lightning bolt' to connect to the FLIR Camera
        v. Create different spots, using "Set measurement spot" icon
        vi. Right click each spot and click Plot
            1. Column creation depends on click order, so click Plot in the correct order
        vii. Right click plot / Plotting Method / Points
        viii. Right click plot / Options
            1. Change Number of Points from 1000 (default) to 10000
                a. 10,000 points + 3.7fps can give you about ~25min of data before the data is overwritten
        ix. Change Frame rate from 15fps (default) to 3.7fps
        x. Data is automatically recorded. You can pause by pushing the pause button. You can clear the plot by right clicking on the plot / Clear
        xi. When ready to obtain data
            1. Right Click plot / Copy / Data

2. Paste into Google Sheets
3. Rename Google Sheet with the test number and name (i.e. 05_DungeonHighGPU).

xii. For heat map
1. Click the camera icon
2. Save image into Documents / FLIR / Images / Date
3. Save with similar name (i.e. 05_DungeonHighGPU).

b. Collect internal zone temperature on Hydrogen Phone
i. Connect Hydrogen phone over USB to Mac or Linux
ii. Download 'thermaltesting' Repo from Github
1. https://github.com/LeiaInc/thermaltesting
iii. Run "./readtemp.sh testname"
1. This needs to be run on Mac or Linux. Currently "xargs" command doesn't work in PowerShell on Windows
iv. 2 files are created (outputData.csv and outputFinal.csv)
v. Open up outputFinal.csv and pull out your specific tests into its own CSV, rename this CSV with your testname
vi. Copy "testname.csv" into Python variable "filename_zone".

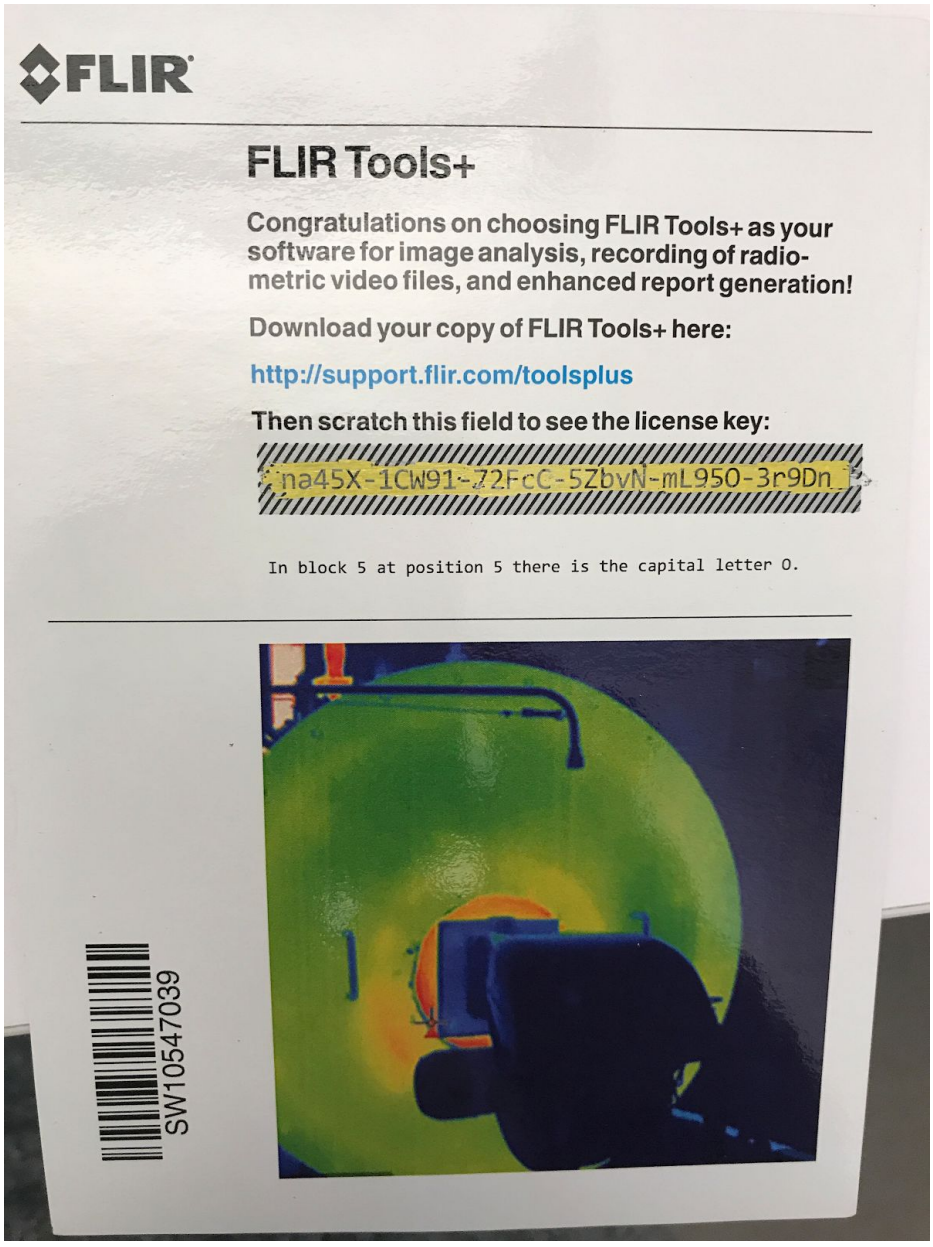
3. Make thermal graphs over time
i. Download Google sheets CSV (20180426 - 05_DungeonHighGPU.csv)
ii. Open up Python, EVT2_1_Thermals2.py
iii. Copy the title of this CSV into filename_flir variable.
iv. Run - this will obtain a graph
v. Paste graph into Power Point

4. Make heat map images
a. In FLIR Tools, go to Library
b. Open up the .jpg image
c. Right click image / Export to CSV
d. Export
e. Save to Documents / FLIR / Images / Date
f. Save to Google Drive / Leia_Engineering_Shared / Android Stuff / Thermal / FLIR ETS320 / Data / Heatmap / Date
g. On Mac
i. Download this CSV
ii. Save into thermaltesting/Date/heatmap
h. Open up heatmap.py
i. Copy this .csv filename in data0 or data1
j. Datadifference subtracts out the data0 from data1 to get a temperature change.
k. Run - this will obtain a graph

Notes

Setup

License key: na45X-1CW91-72FcC-5ZbvN-mL950-3r9Dn



Good thermal image

1. Ensure camera is saving radiometric images

2. Choose appropriate temperature range. Need to be in manual mode, not automatic mode
3. Change temperature intervals to adjust contrast and brightness
4. Focus
    a. Change distance from object
5. Temperature Range
    a. Choose the lowest possible temp range available on the camera, but must include the highest temp in the image.
    b. Must choose appropriate temp range to match the amount of incident radiation
        i. Because “exposure” is preset by the image frame rate. Can’t choose how much radiation hits the camera detector
        ii. Higher temps emit more IR than colder objects.
    c. Range too high → image is underexposed
    d. Range too low → image is oversaturated
6. Image detail and distance from object
    a. Area of interest should take up the whole thermal image.
        i. Spot tool must be completely filled by the object for correct temperature measurements
7. Changeables
    a. Adjust contrast and brightness. Helps ID the area of interest
    b. Palettes and isotherms
        i. Palettes
            1. Gray - resolve small geometric details. Not good for small differences in temperature
            2. Iron - very intuitive. Good balance between geometric and thermal resolution.
            3. Rainbow - greater contrast, but noisy image
        ii. Isotherm
            1. Displays a given interval of the same apparent temperature in a color that is different from the palette. This lets you emphasize temp patterns in the image