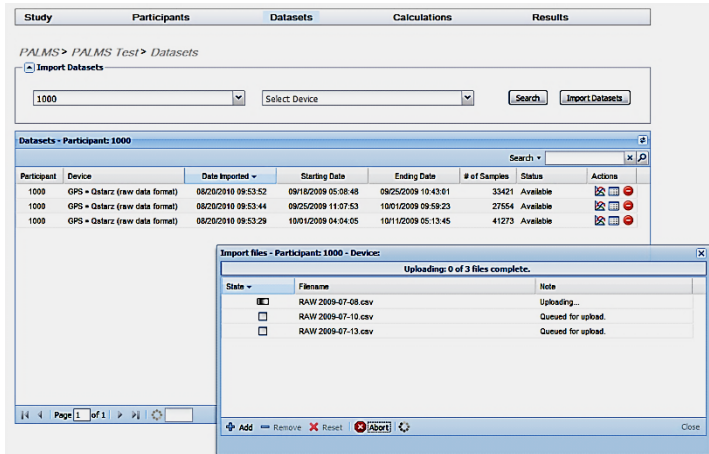


PALMS: Personal Activity Location Measurement System

Temporal / Spatial Analysis of Personal Sensor Data

PALMS is a secure web application that enables you to discover the personal activity patterns of individual participants in free-living research studies. By outfitting participants with a GPS data logger and physical activity monitor, you can construct a detailed picture of a participant's day: travel patterns, locations, time sequences; times, duration, locations and levels of physical activity and sedentary periods. Adding a personal environmental sensor can provide individual exposure and dosage measures synchronized in time and space.

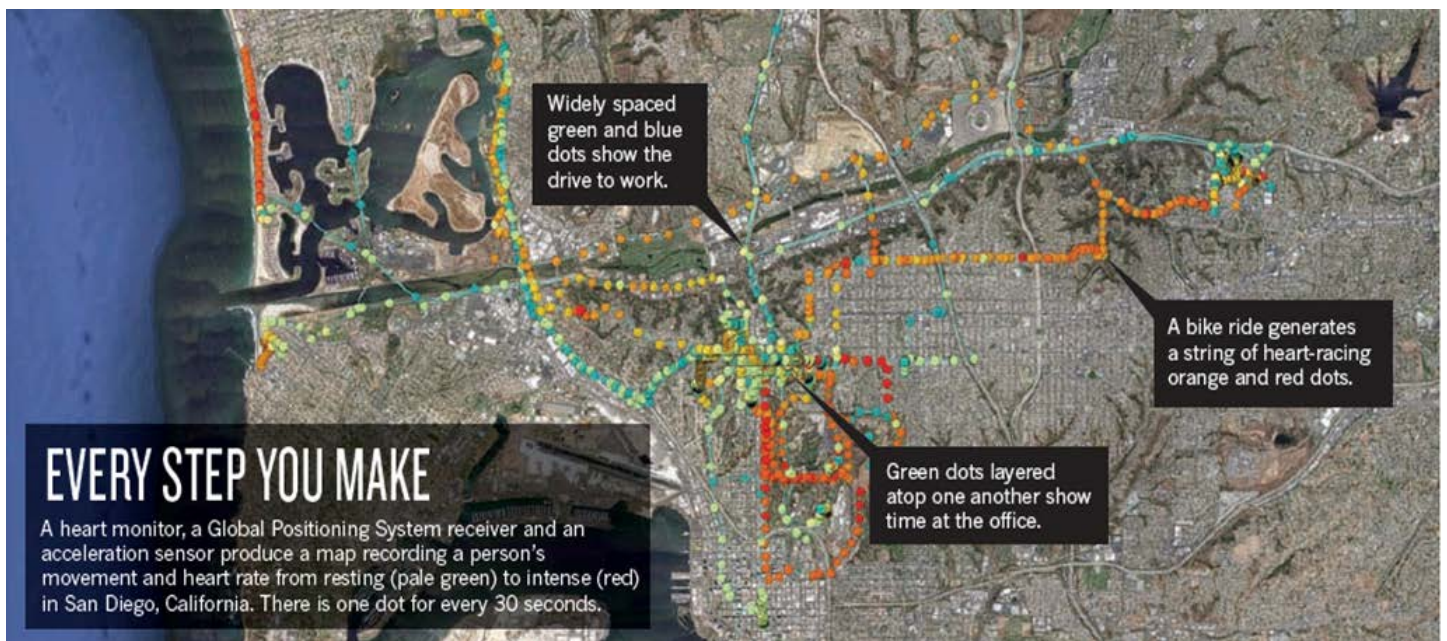
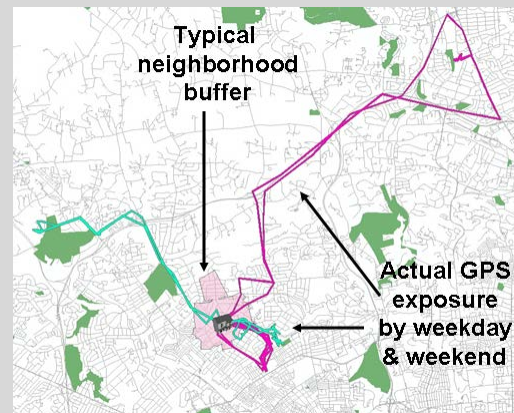


PALMS web interface

PALMS accepts time-stamped data streams from a variety of devices, adjusts the epochs, aggregates the samples, cleans, filters and classifies the data, and merges the results to create a minute-by-minute dataset of a person's day. These datasets can be exported to spreadsheets, statistical packages and/or GIS systems. PALMS can also summarize the data and create KML files for display in Google Earth.

Importance of Place, Physical Activity & Exposure

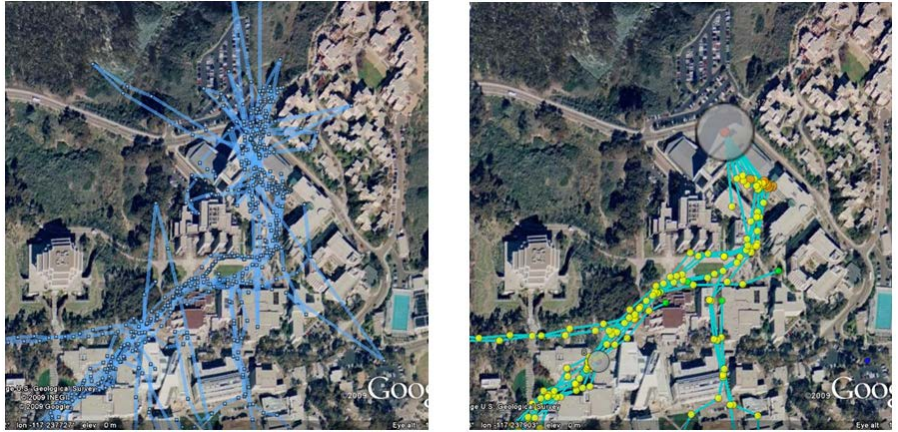
- Current behavior studies estimate spatial characteristics based upon residence or school/work location buffers rather than actual exposure to environments across the day.
- Concurrent & continuous measurement of PA/sedentary behavior and exposures of interest will be essential if researchers are to understand relationships between behavior locations and health.
- Routes and locations that intersect with healthy & unhealthy environments can be studied dynamically and models weighted for speed of travel or time of day.



PALMS featured in the Feb 16, 2011 issue of Nature on measuring the human "exposome".

PALMS GPS Processing

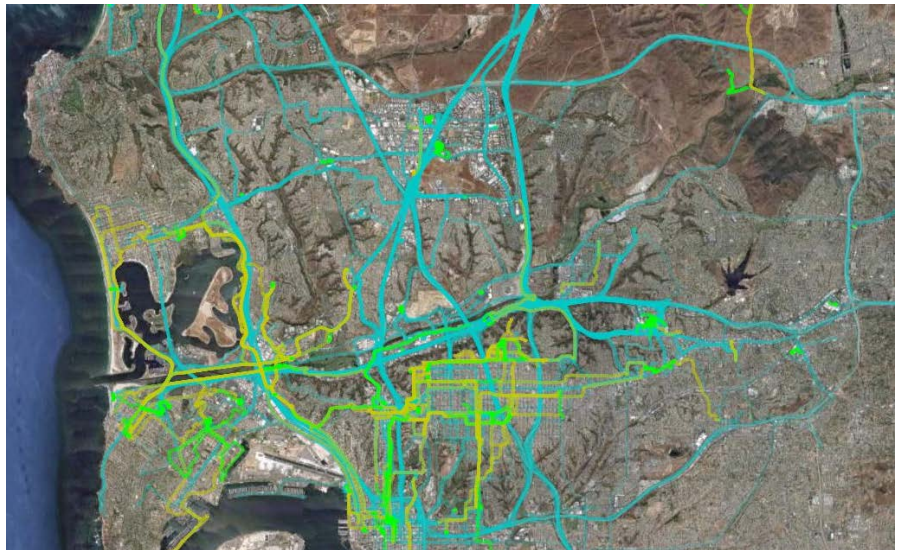
- Filters (removes) grossly invalid fixes, extraneous and redundant trackpoints
- Uses SNR (if recorded by GPS) to determine indoors vs. outdoor trackpoints
- Detects trips marking departures, arrivals, pauses and in-motion trackpoints
- Estimates mode of transportation
- Detects locations, time spent, number of visits
- Optionally, collapse points within predefined radius to location center



GPS data before and after processing by PALMS

PALMS Accelerometer Sensor / Heart Rate Monitor Processing

- Detect and mark non-wearing conditions
- Detect and mark bouts of activity and sedentary periods
- Classify periods of activity as light, moderate, vigorous and very vigorous
- Filter out erroneous heart rate spikes and dropouts
- Apply moving average to smooth heart rate
- Classify heart rate intensity
- Estimate energy expenditure



Travel patterns in San Diego bicycle commuting study

The PALMS Cyberinfrastructure

PALMS is built for growth in storage and processing power by computer scientists engaged in addressing other large scale data challenges. It supports a growing community of users who can share experiences, methods and data. Data from a variety of devices is stored using a common data schema to enable sharing across studies.

PALMS Future Directions

- Incorporation of environmental data from personal wearable sensors
- Incorporation of external data sources: air quality, weather, etc.
- Use of machine learning techniques in PALMS calculations
- Future studies will include ambient light data from the person-worn SenseCam

Researcher's Usage of PALMS

As of 10/1/2011 PALMS is being used by 45 researchers in 8 countries and contains data on over 1,500 participants. Study aims include:

- Assess influence of built environment on teenagers' active transportation
- Better understand barriers and facilitators to physical activity among older adults
- Better understand movement patterns of Latinas and their utilization of parks
- Assess mobility of cancer patients after discharge from hospital



Personal Activity Location
Measurement System
UCSD / Calit2

For More Information

- visit the PALMS wiki at <http://ucsd-palms-project.wikispaces.com>
- email: palms@ucsd.edu