Problem: SLAM algorithm with no odometry available.

We have a Markov process. After processing to the point with high confidence we may recalculate all previous positions - close loop.

Close loop examples??????

Reestimate previous coordinates - regression task.

\section{measurements model}

acceleration data from imu \\ magnetic field orientation vector \\ RSSI

Consider the process is Markovian.

\section{Transition model definition}

Copied all from \cite{articleXia}:

With the development of microelectromechanical systems(MEMS), a few MEMS-based sensors have been built and incorporated into smartphones: accelerometers, gyroscopes,magnetometers, etc. These sensors can be used to provide information on the user’s actions. Pedestrian dead reckon-ing (PDR) [10] is a relative navigation technique that uses these sensors.

we propose a PDR-based indoor positioningmethod that integrates RSSI with indoor environment mapconstraints by using particle filters.

PDR-based indoor positioning can be expressed by the following equations

\(\begin{equation} X_k = \ \begin{bmatrix} x_{t-1} \\ y_{t-1} \end{bmatrix} = \ \begin{bmatrix} x_{t-1} &+ l_k \sin(\theta_t) \\ y_{t-1} &+ l_k \cos(\theta_t) \end{bmatrix} + \ \begin{bmatrix} \delta_{x} \\ \delta_{y} \end{bmatrix} \end{equation} \)

The orientation updates is independent from X_k updates, depends on accelerometer and gyro, same model.

Step Detection:Android mobile phones have two kinds of sensors to monitor steps: step counters and step detectors [25].

Peak detection is used in this paper for step detection

nonlinear step length estimation model based on statistics proposed by Weinberg [27] \begin{equation} step_{size} = k \sqrt^4{a_{z max} - a_{z min}} \end{equation}

The Android system computes orientation angles by using the device’s geomagnetic sensors in combination with its accelerometers [25]. Using these two hardware sensors,the system provides data for the following three orientation angles

The device is NOT assumed to be pointing in the heading direction. Need to apply additional space transformation.

\subsection{RSSI methode}

Usual path-loss model:

\begin{equation} PL(d) = PL(d0) + 10 \alpha \log{d / d_0} + \omega = PL(d0) + 10 \alpha \log{d / d_0} + N(0, \sigma^2_{\omega}) \end{equation}

where d represents the Euclidean distance between the anchor node and the receiver,d0represents a specified distance,PL(d)and PL(d0)represent the RSSI at d and d_0, respectively(in dBm), andαrepresents the path loss exponent, which is closely related to the ambient environment;ωis a zero-mean Gaussian distribution variable with variance σ^2_{ω}.

The inverse function: \begin{equation} d_i = d_0 \cdot 10 \frac{PL(d_i) - PL(d_0)}{10\alpha} \end{equation}

Landmark model:

\begin{align} f_i(x, y) &= d_i - \sqrt{(x - x_i)^2 + (y - y_i)^2} \\ min(x, y) &= min \sum_{i=1}^{m}[f_i(x, y)]^2, m \ge 3. \end{align}

In paper author transform this to linear system,

\begin{align} AZ & = b \\ A &= \begin{bmatrix} 1 - 2 x_1 - 2 y_1 \\ … \\ 1 - 2 x_m - 2 y_m \end{bmatrix} \\ Z &= \begin{bmatrix} x^2 + y^2 \\ x \\ y \end{bmatrix} \\ b &= \begin{bmatrix} d_1^2 - x_1^2 - y_2^2\\ …\\ … \end{bmatrix} \end{align}

We have to check it

Good alternative was proposed in \cite{} to bound region by min and max RSSI according to its variance - linear system.

\subsection{Processing}

Update step, prediction, correction State Estimation

Resample:In this step, importance resampling [20] isused to obtain a new particle set

some papers prove importance resampling can’t be applied for this task because pf noise. % observation equation:

\section{Crasy Idea}

There is some similarity in video compressing process

We strore gradients of changing signal measurements, we apply searching procedure to have a smooth measurements.

We have a convex magnetic field and a trajectory, the task is to find similar trajectrory with highest correlation to measurements.

Regression, approximation, pattern matching, Convolutions.

Gradients, blockmatching

Different approaches in papers, play on a toy model.