Probabilistic Palm Rejection Using Spatiotemporal Touch Features and Iterative Classification

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Prior Software-Only Approaches
palm rejection region
Our Approach

Collection of decision trees, spatiotemporal features.

Handedness and orientation agnostic.

No calibration required.
green = stylus
blue = palm

Palms have large radius.

Palms flicker in and out.

Stylus is isolated.

Palms move little, styluses have smooth trajectories.
Instantaneous Features

Touch radius

Distance to other touches on screen
**Touch Sequence Features**

- $[\mu, \sigma, \text{min}, \text{max}]$ touch radius over sequence
- $[\mu, \sigma, \text{min}, \text{max}]$ distance to other touches in sequence
- $[\mu, \sigma, \text{min}, \text{max}]$ velocity, acceleration
Touch Sequence Features

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train: 11,000 instances from 3 people

test: 11,000 instances from 2 different people

train and test data gathered in different locations and on different days

* leftmost point is at t = 1ms
Window size of ~250ms would be ideal.
Want to provide immediate feedback to the user.
t

-100ms -50ms 0ms 50ms 100ms ...

-50ms -100ms

= palm

= palm
-100ms  -50ms  0ms  50ms  100ms  ...

-50ms

0ms

50ms

100ms

$t$

○ = palm

○ = stylus
final classification

-100ms
-50ms
0ms
50ms
100ms

= palm

= stylus

= stylus

= stylus

= palm
Evaluation

Penultimate vs. Bamboo vs. Our App
symbols:

SO•IL
symbols:

\[ \text{SO} \cdot \text{IL} \]

false negative
% pen strokes classified as pen strokes
error bars = 95% confidence interval
symbols:

SO•IL

false positive
# of palm ‘splotches’ per pen stroke
*error bars = 95% confidence interval
Takeaways

Waiting to see how sensed input evolves before making a decision improves recognition accuracy.

Need a system that can show immediate feedback, but that can refine the interface as more information is presented.
Thank you!

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Why a decision tree?
Limitations

No multitouch gestures (yet)

Algorithm overly reliant on touch radius

Accuracy hit of 1% when not using radius features

Difficult to implement on platforms that do not expose touch radius