BALL MODEL

Sequential clustering algorithm

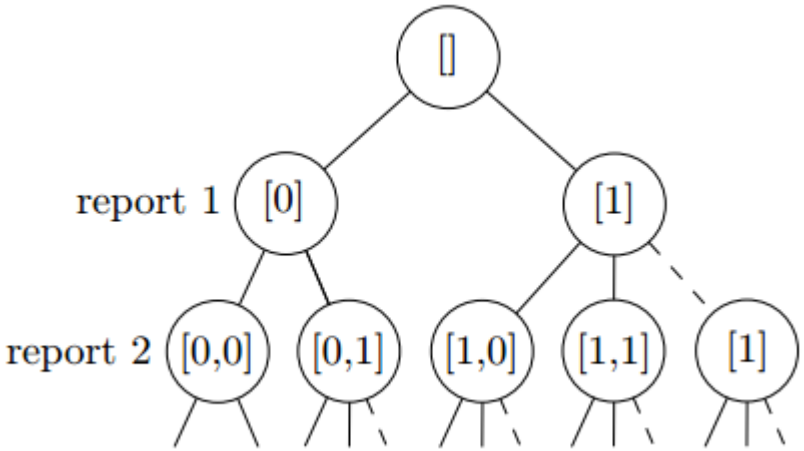
1. A hypothesis tree is expanded for each new observation
2. For each object in the hypothesis tree, the current state is estimated
3. A likelihood update is applied
4. The hypothesis tree is pruned so it stays maintainable
5. The hypothesis with the highest probability is selected

BALL MODEL

Expanding the hypotheses-tree

A new observation can be classified as:

- ‘clutter’
- a new observed ball
- belonging to an already observed ball



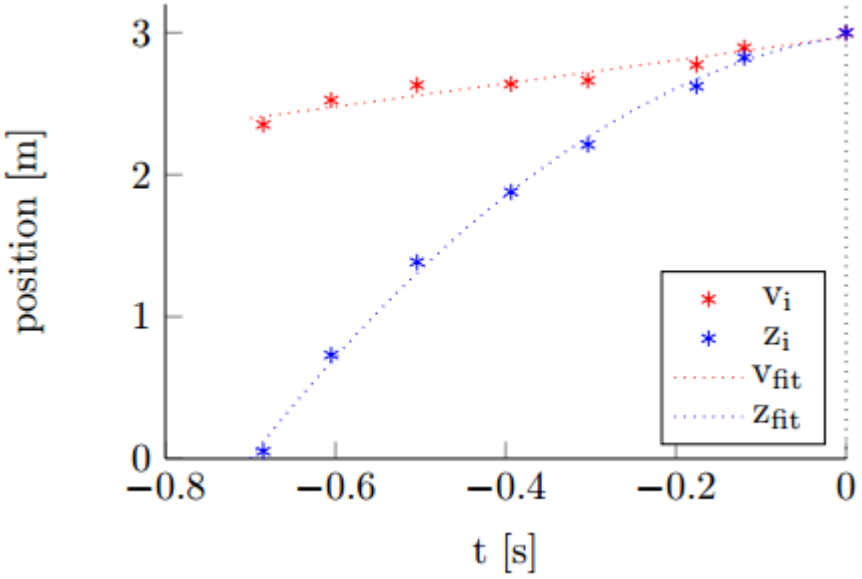
For each hypothesis:

- ball-associated features are stored in a buffer
- the buffer is cleaned when a feature is associated with a new ball

BALL MODEL

Current ball state estimation

- Batch-wise least-square estimation of the current state is performed
- Minimum number of features is required
- Linear regression on (gravity-compensated) data
- Inverse variance used as weighting factor



BALL MODEL

Likelihood update

- Probability of each hypothesis is propagated
- Normal distributed function

$$p = \exp(-\frac{1}{2}\left(\frac{x^2}{\sigma^2} + \frac{y^2}{\sigma^2} + \frac{z^2}{\sigma^2}\right))$$

- x, y, z : decribe the distance between the estimated position and the new feature
- σ : standard deviation sigma that is provided by the new feature

'Clutter' likelihood: 1−p

BALL MODEL

Pruning

Branches are removed when:

- Low probability
- Outside the bounds of the field
- Have not been updated for a while

Problem: **future potential** but **currently non-potential** hyps may be **removed**

Example: clutter hypothesis

Solution: do not prune clutter hypothesis and reset probablility

BALL MODEL

More-over

- Tracking of multiple balls is possible with the current ball model
- An observer update to reconstruct a desired post-event velocity

  Examples:
  - initial kick velocity
  - post-bounce velocity

LOBPASS

Demo

- Predefined starting positions
- Obstacles are taken into account when choosing a pass target
- Lob pass with bounces is desired for more receiving time
- Robust intercept strategy with hysteresis
- Positioning towards intercept is good, catch-rate low

LOBPASS