

Fast Online Segmentation of Activities from Partial Trajectories

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When a robot collaborates with people in groups, understanding the activities of the people it is working with (with specific reference to the timing of those activities), allows the robot to generate an efficient and collaborative plan to perform its actions. In this work, we introduce an online activity segmentation algorithm that can detect activity segments by processing a partial trajectory: an essential first step for a robot to generate an efficient interaction plan.

Activity Segmentation Algorithm (FOSAPT)

- FOSAPT works in two steps:
 - Tracks activity progress.
 - Models activity transitions and performs refinement of activity segments in parallel.

Activity Classification vs Segmentation

- Segmentation:** Identifying the start and end times of each activity segment within a trajectory and assigning the appropriate corresponding activity label to each segment.
- Classification:** Applying correct label to a given trajectory.

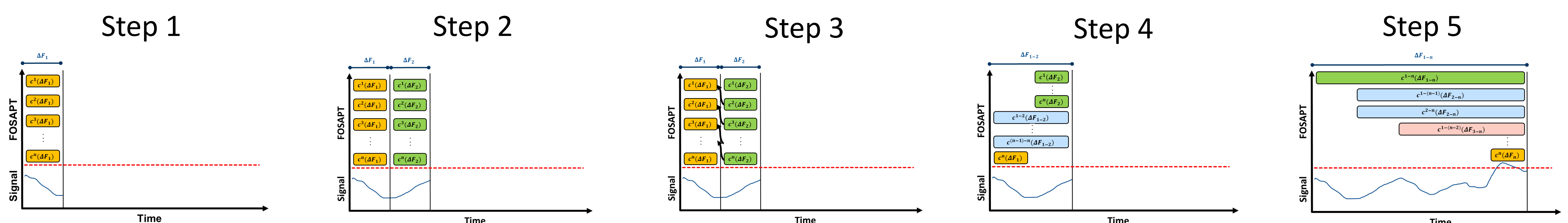
Activity Progress Tracking

- Utilizes a supervised activity classifier to measure the likelihood of a segment.
- Performs a merging operation to compute the likelihood of a larger segment from already-computed likelihoods of smaller segments.
- To keep the computation tractable, utilizes a particle filtering approach and task model information about the partial order of activities.

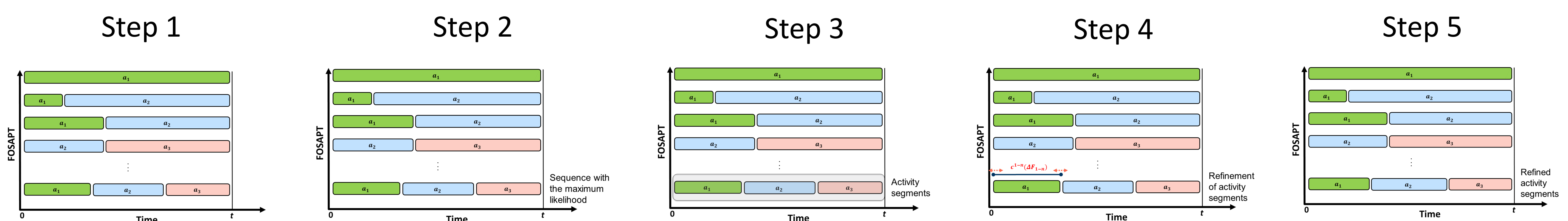
Activity Transition Modeling and Refinement

- Uses a Bayesian changepoint detection approach to track the activity transitions overtime.
- The probability of an activity segment is computed as:
 $prob = duration_stat * fit_prob * prior(a) * prev_MAP$
- FOSAPT's segmentation approach is complemented by an online search process to refine activity segments, along with predictive models of the timing of future activities.

Activity Progress Tracking

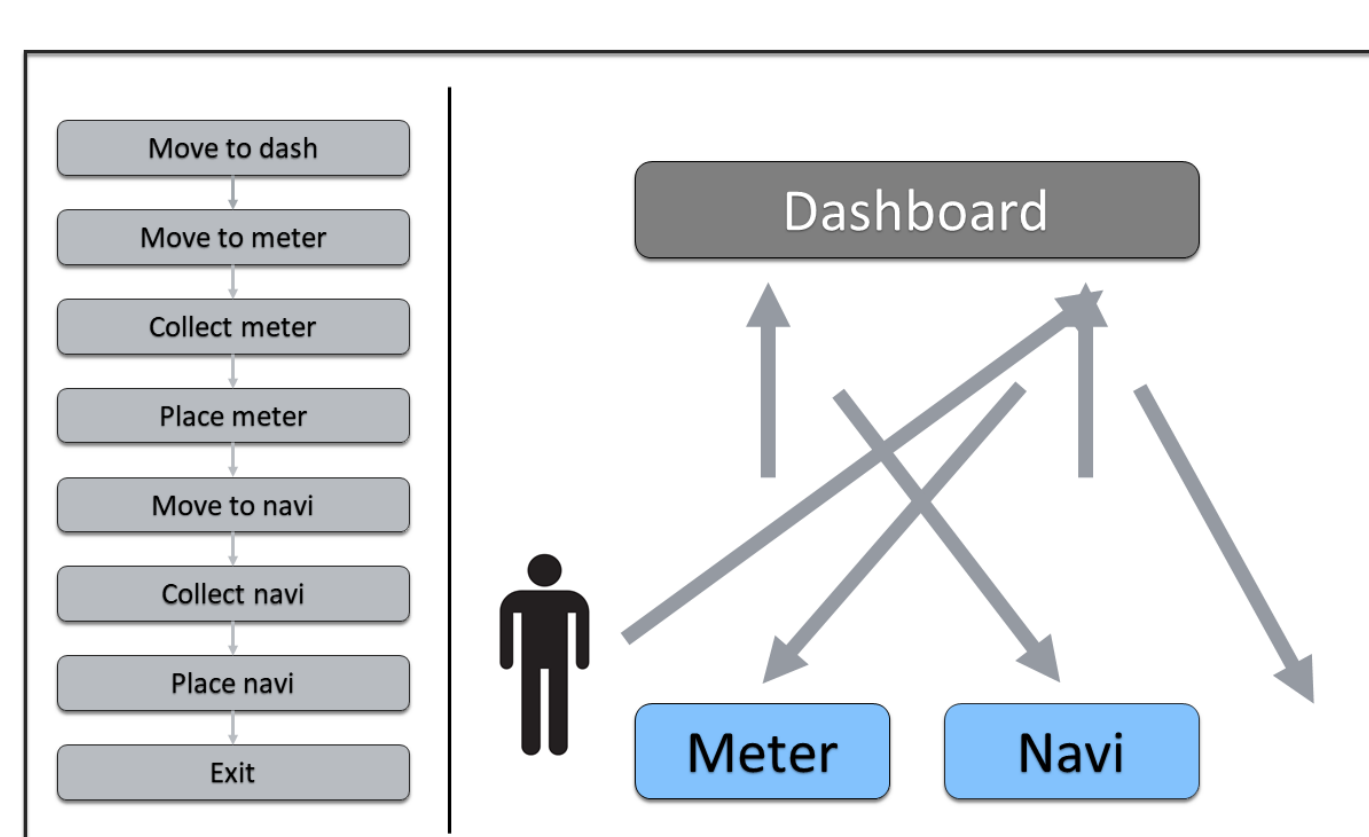


Activity Transition Modeling and Refinement



Experiments

- An automotive dashboard assembly task.
- Twelve factory associates participated in the study.
- Each person performed a total of four conditions.



Segmentation Accuracy (%)

Algorithms	Datasets		
	Auto-DA	UTKinect	Static-Reach
FOSAPT	72.2	70.5	88.8
BATCH-RAPTOR-CPD	43.9	43.4	20.0
TSC	6.7	59.2	69.6