People Watching: Human Actions as a Cue for Single View Geometry

David Fouhey et al.

Experiment Presentation by Edward Banner

Outline

- Dataset
- Overview of model
  - Which components I experimented with
- Experiments
  - Where are gains coming from?
  - Noisy functional surface estimates?
  - Use different heatmap information?
  - When does the model perform poorly?

Thanks David Fouhey!

Dataset

- 141 timelapse YouTube videos (versus 40 in the paper)
- Larger and more challenging

- http://www.di.ens.fr/willow/research/scenesemantics/

Example Room

Pipeline

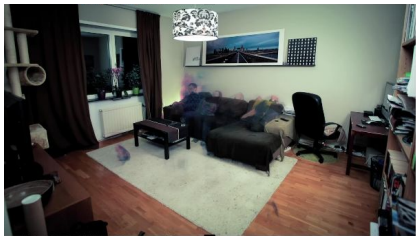
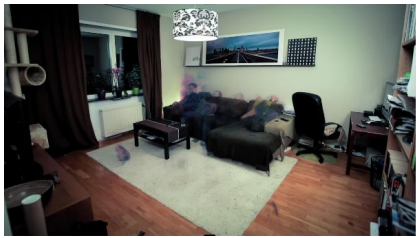


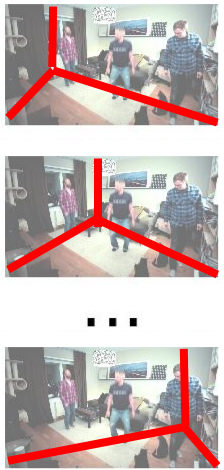
Image credit: Fouhey et al.

Pipeline

Room proposals

- Headau et al.





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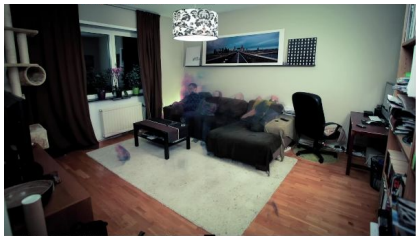

Action and Pose Detection

- Felzenswab et al.
- Yang and Ramanan

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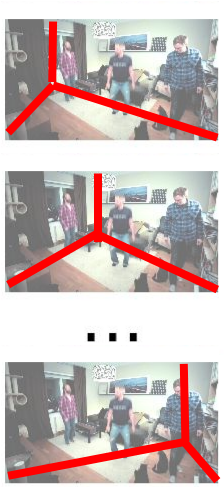

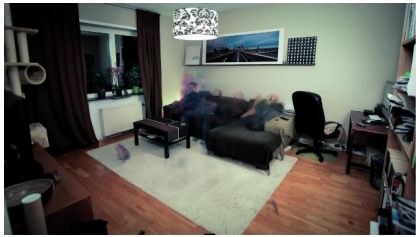

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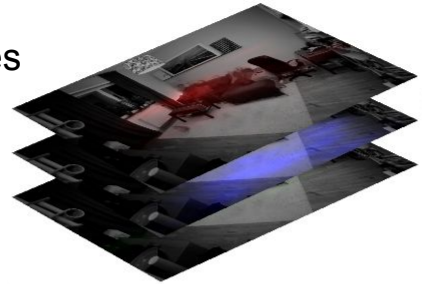
Estimates of
Functional Surfaces

- Standing
- Sitting
- Reaching



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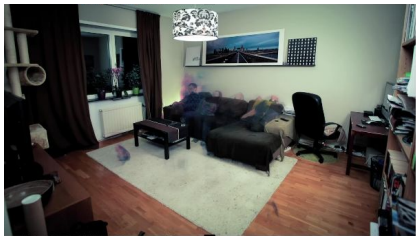

Re-ranker

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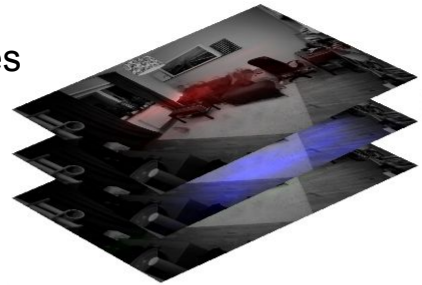

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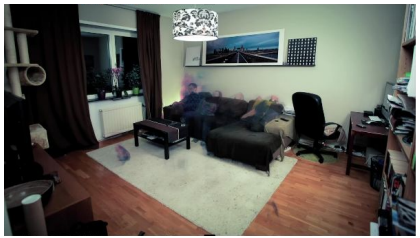
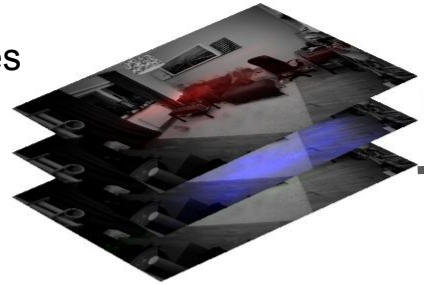
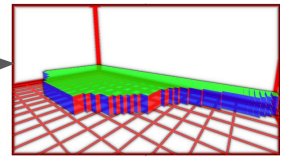


Re-ranker

Free Space Estimation





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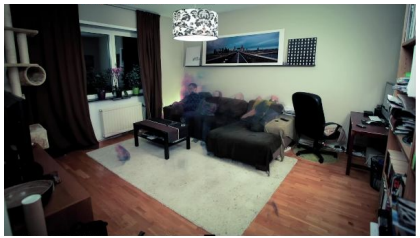

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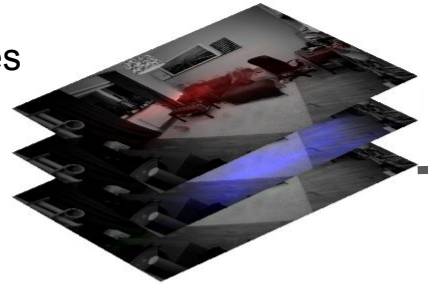

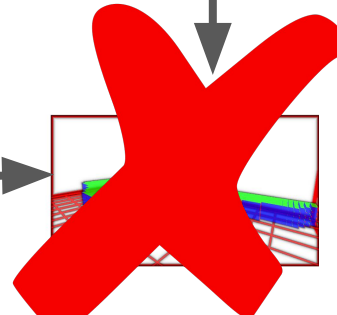

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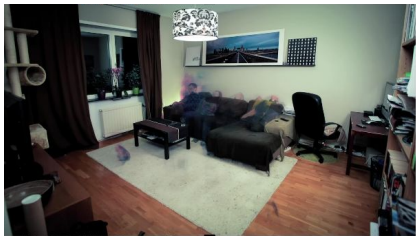

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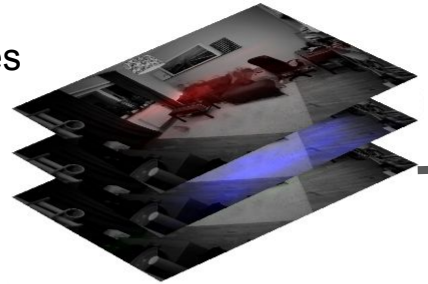

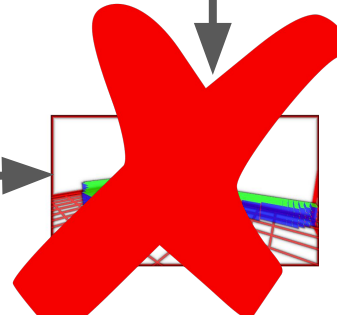

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Experiment 1: Ignoring functional surfaces

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$$f(x, H, y) = \psi(x, y) + \phi(H, y) + \rho(y)$$

Image features

Human actors (walkable area)

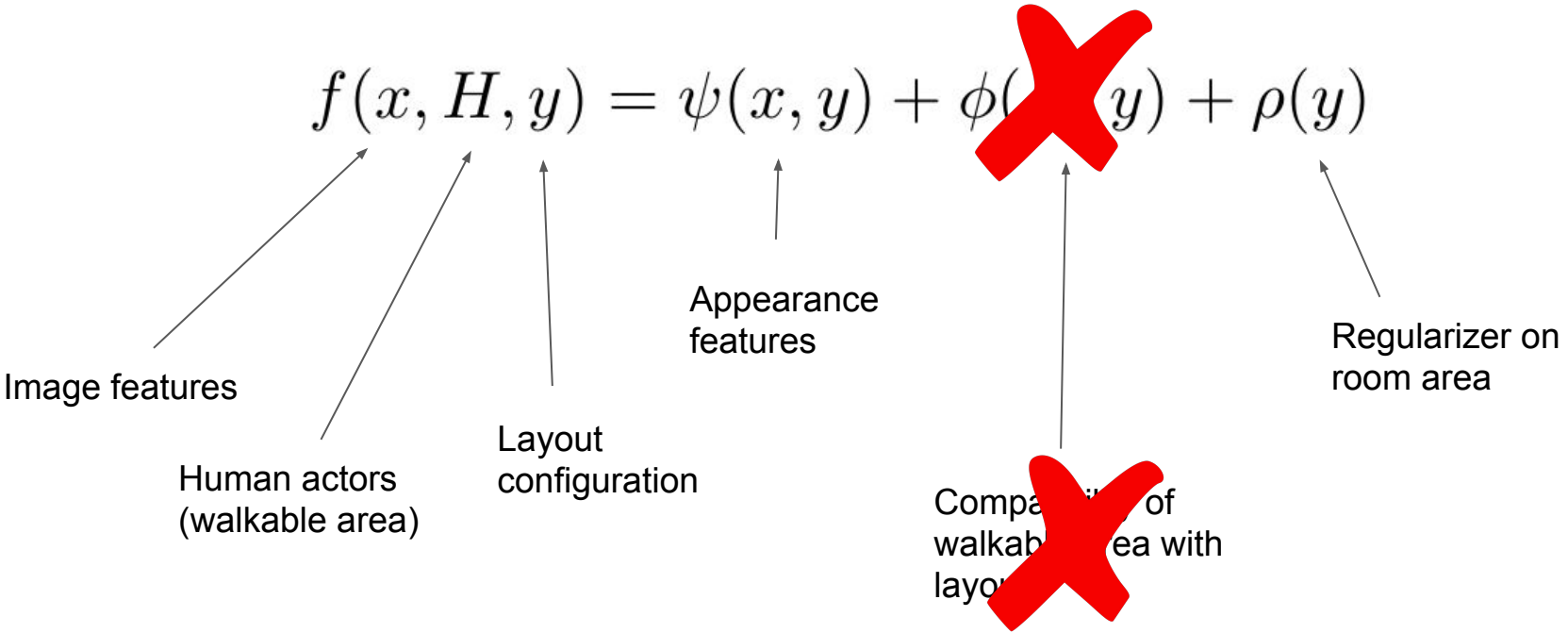
Layout configuration

Appearance features

Compatibility of walkable area with layout

Regularizer on room area

Experiment 1: Ignoring functional surfaces



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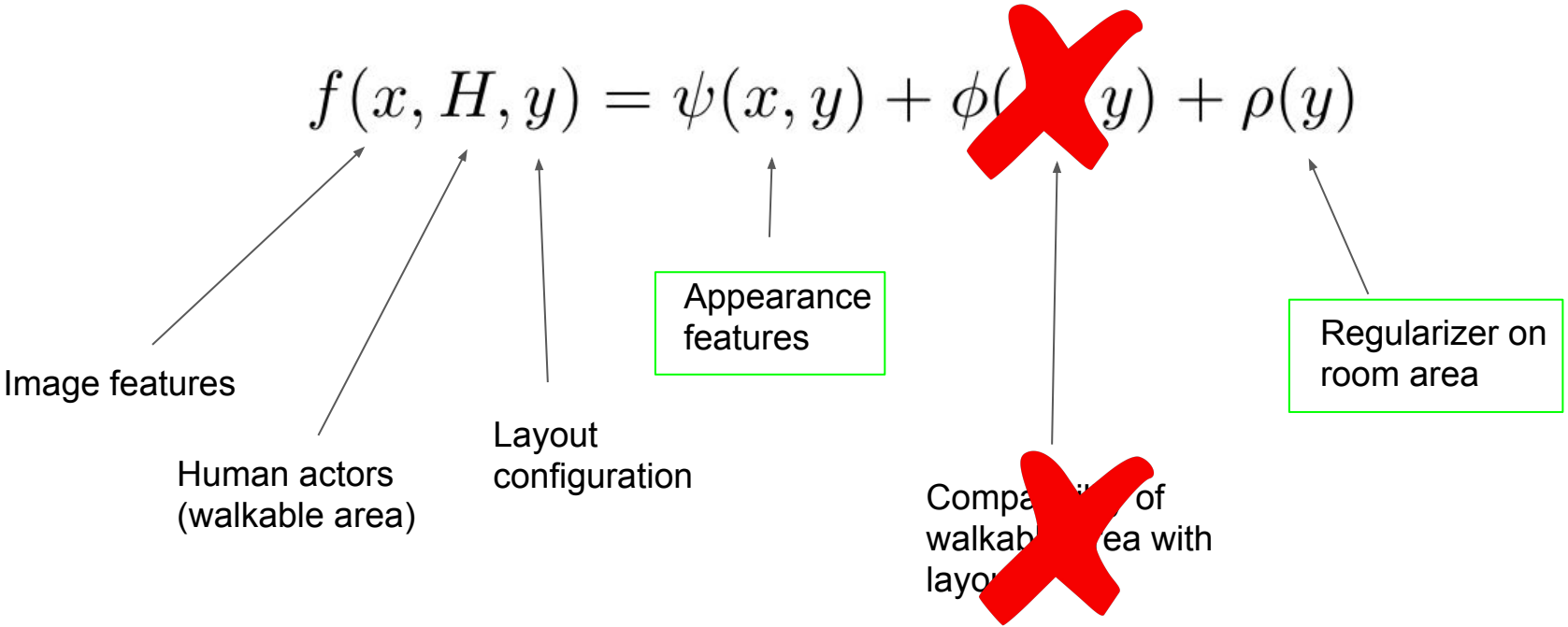

Encouraging Larger Rooms: **Successes**

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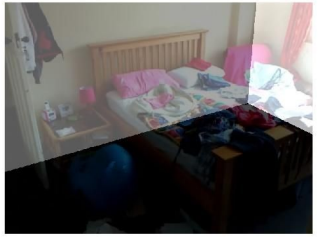

Appearances Feature Only

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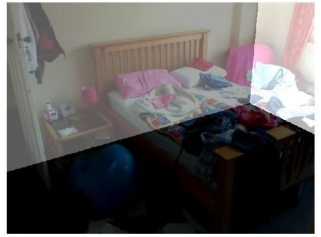
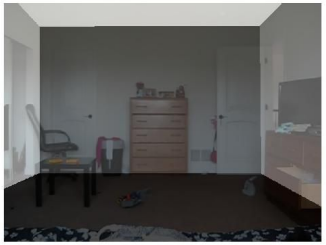


Appearances Feature Only

Low Penalty

Low Area Penalty: **Failures**

Encouraging Larger Rooms: **Failures**



Appearances Feature Only

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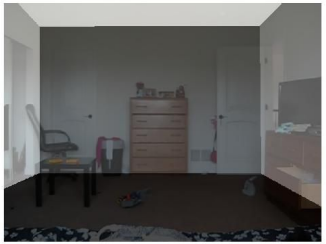

Appearances Feature Only

Low Penalty

Encouraging Smaller Rooms: **Successes**

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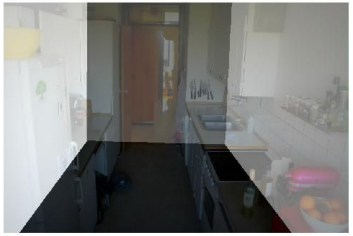

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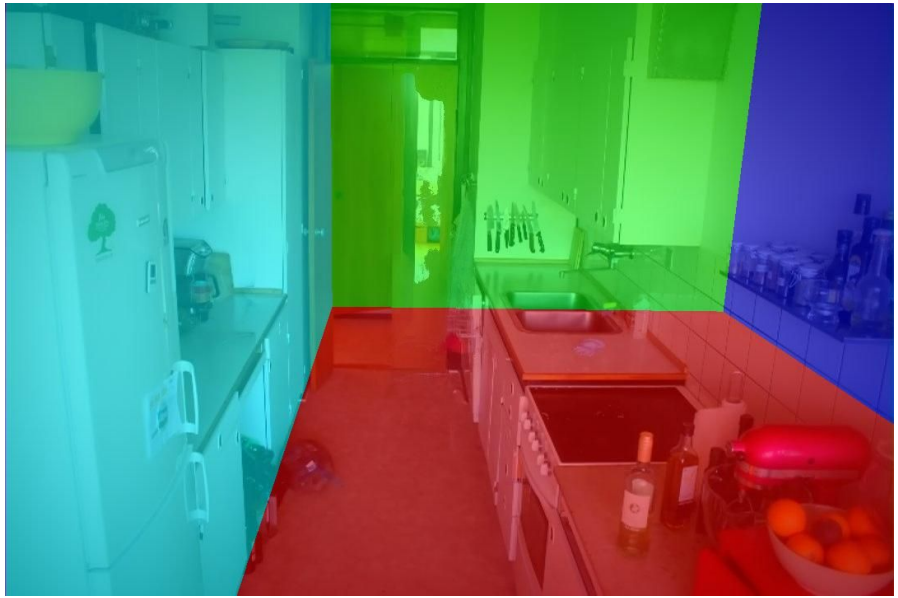

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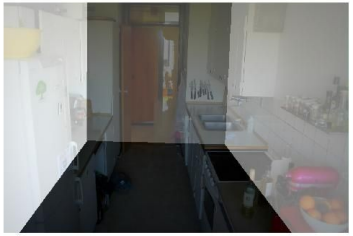

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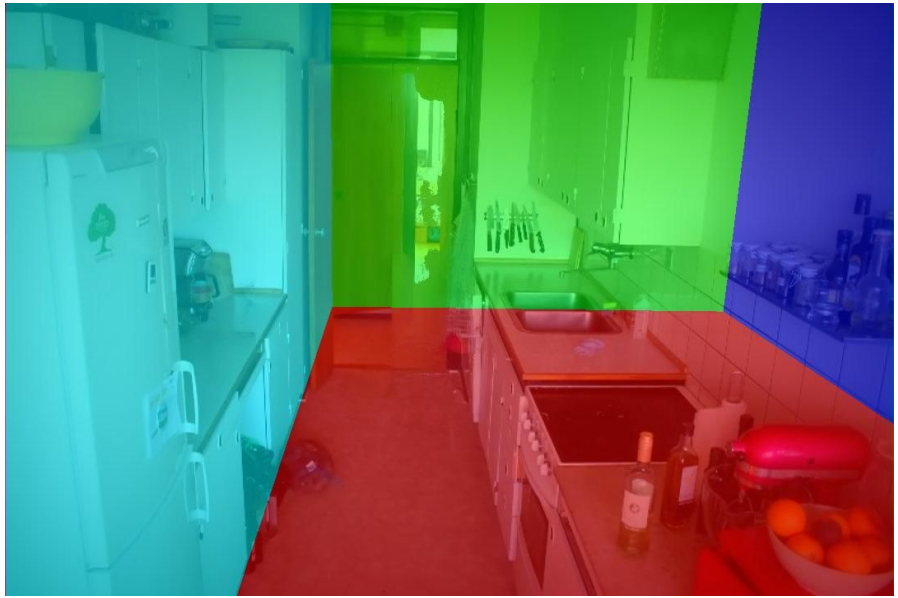

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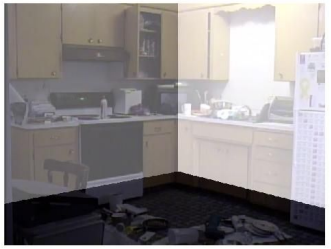

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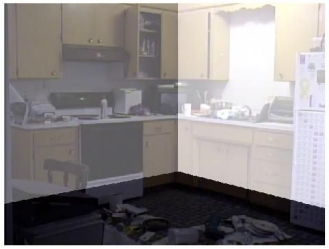

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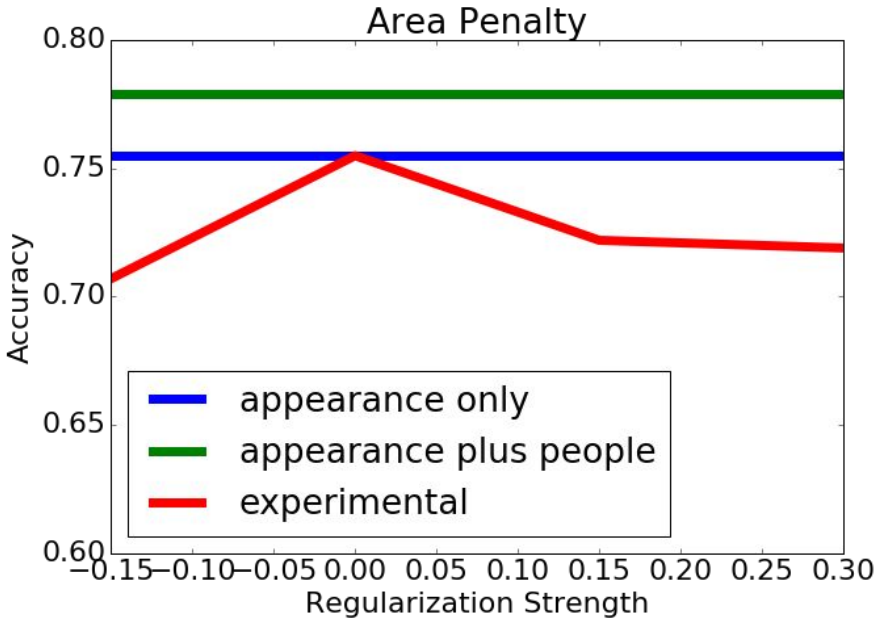
High Penalty

Experiment 1: Ignoring functional surfaces

20 timelapses

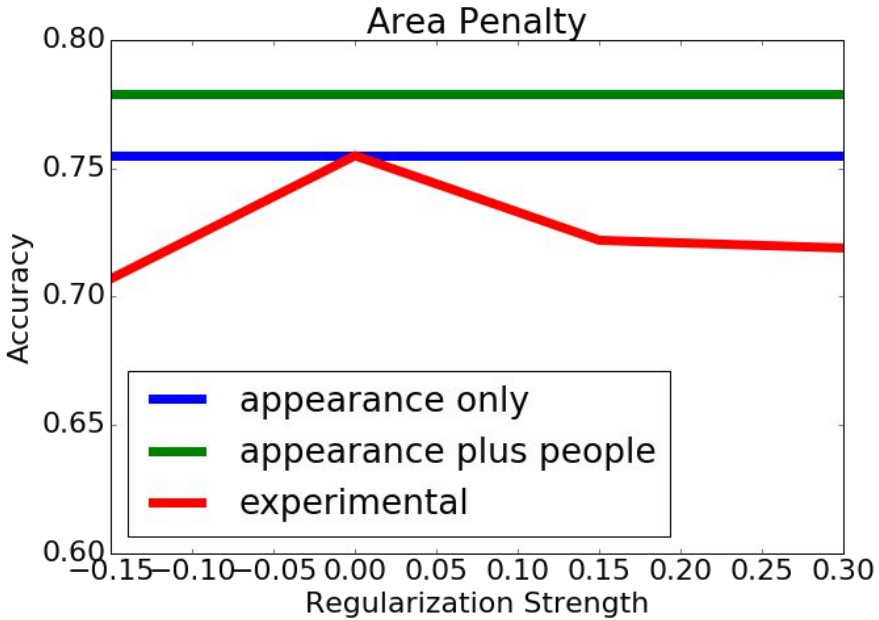


Experiment 1: Ignoring functional surfaces

20 timelapses

Conclusions:

- System ***is*** getting gains from human surface estimates!



Experiment 2: Robustness to pose estimation error

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- Sparsify estimates
- Diffuse estimates

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- **Sparsify estimates**
- Diffuse estimates

Experiment: Sparsifying Functional Surface Estimates

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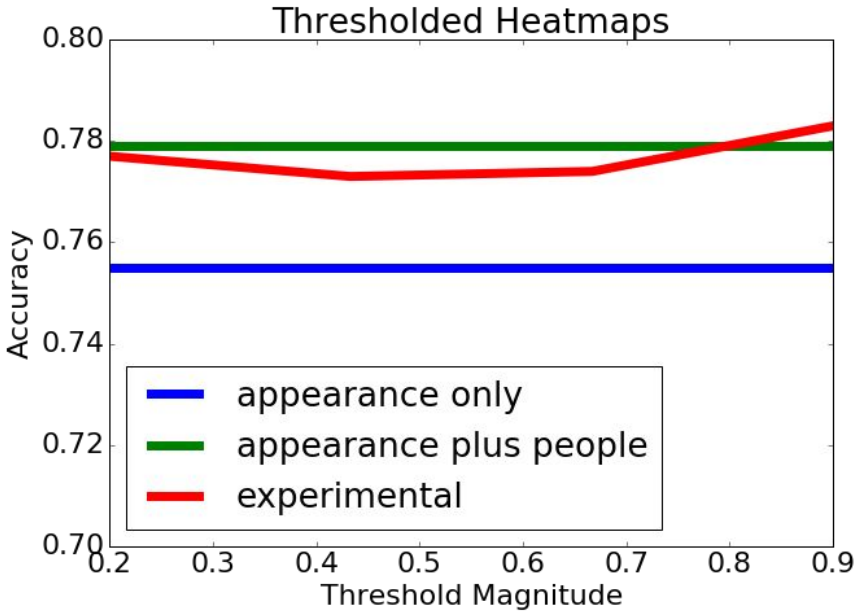

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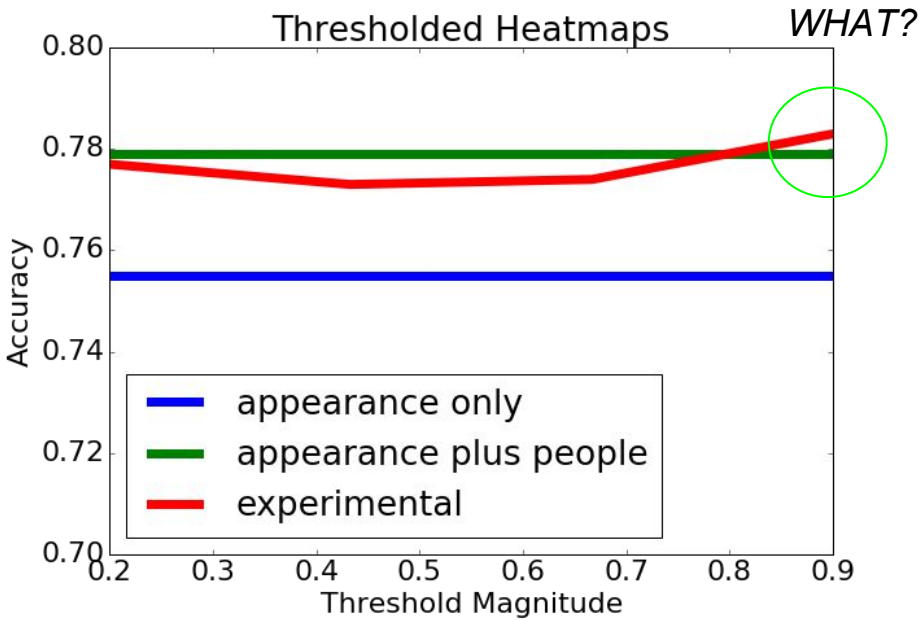
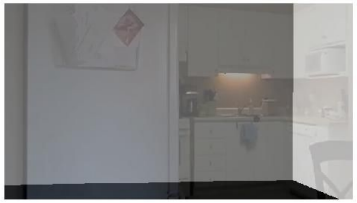


Sparsifying Walkable Area: **Successes**



Full Walkable Estimates

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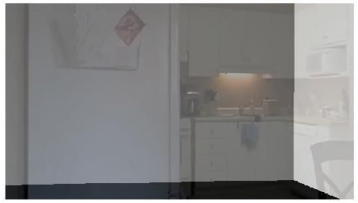


Full Walkable Estimates

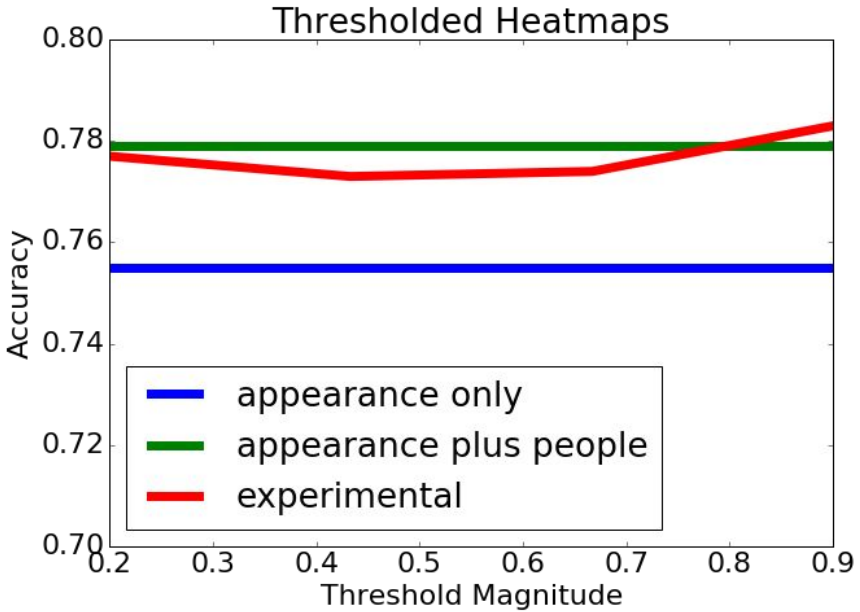
90% Thresholded Heatmap

Experiment: Sparsifying Functional Surface Estimates

20 timelapses

Conclusion: Spurious example. More data needed!

Model is surprisingly resilient!



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Diffusing Walkable Areas: **Failures**

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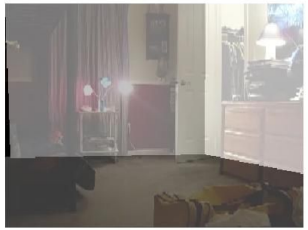
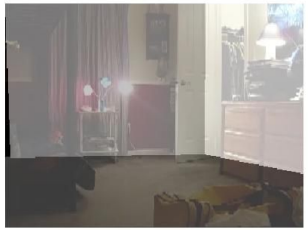


Appearance Feature Only

Failures!

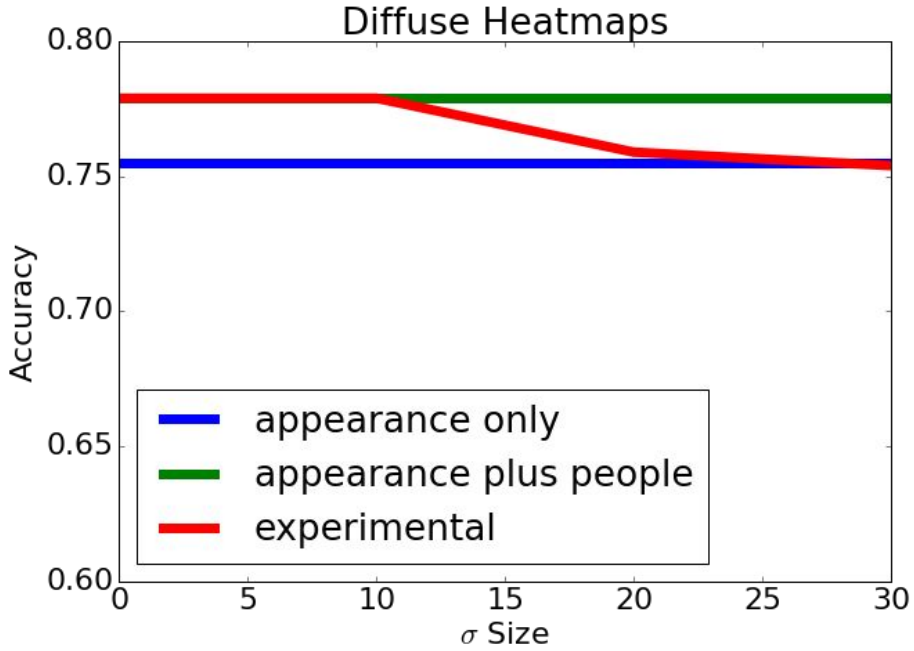


Appearance Feature Only

High Diffuse Level

Experiment: Making Heatmaps more Diffuse

20 timelapses

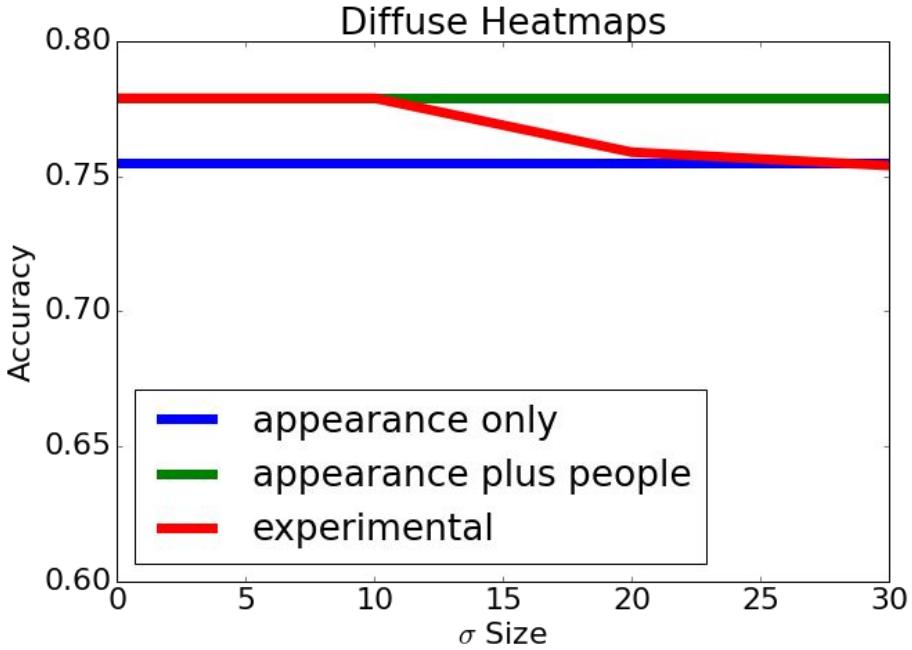


Experiment: Making Heatmaps more Diffuse

20 timelapses

Conclusion: Making walkable areas more diffuse has similar effect to encouraging larger rooms.

Model is fairly robust!



Experiment: Using only sittable regions

Containment constraint: Walkable area must be within the proposed room

Sittable area obeys this constraint!

Using Only Sittable Regions: **Succeses**

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Just Standable

Using Only Sittable Regions: **Succeses**

Just Standable

Just Sittable

Using Only Sittable Regions: **Failures**

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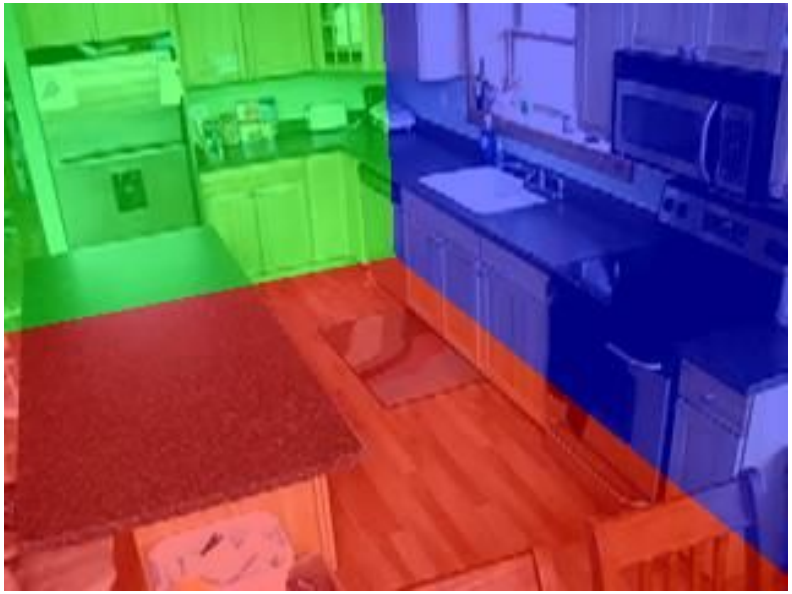
Just Standable



Using Only Sittable Regions: **Failures**

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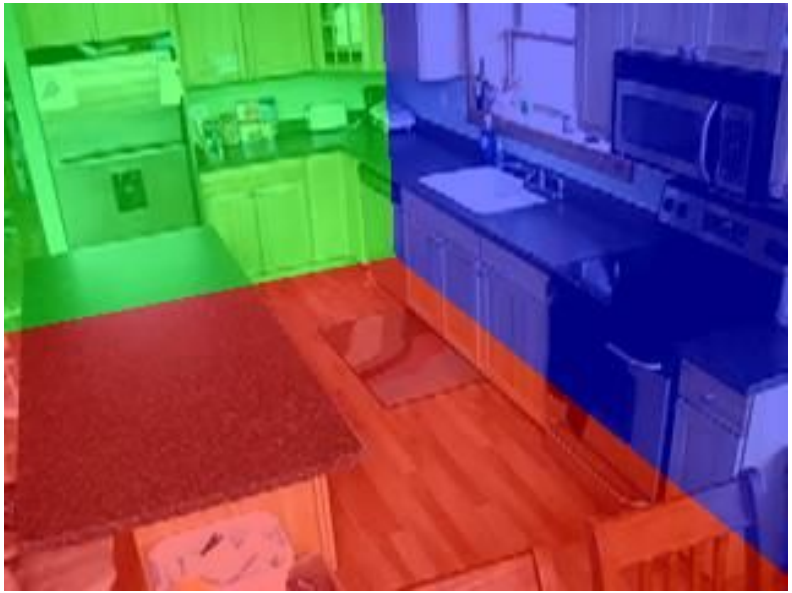

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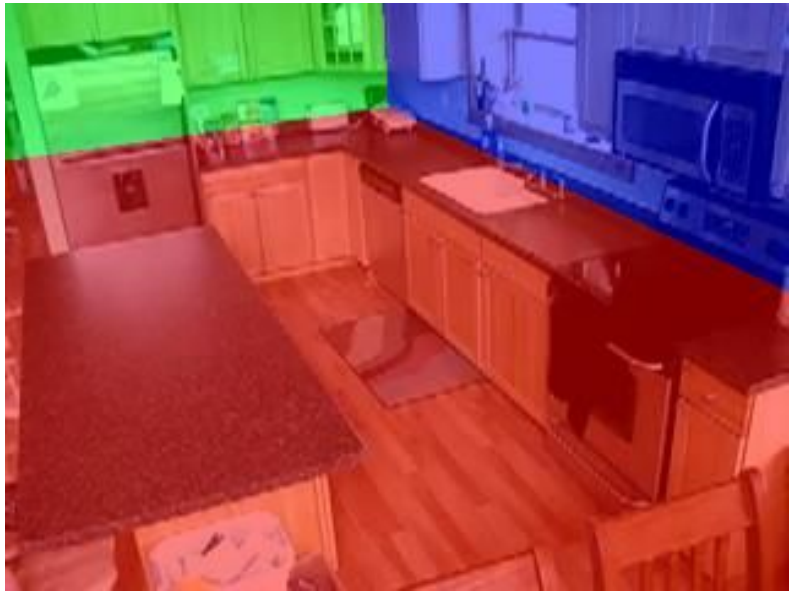
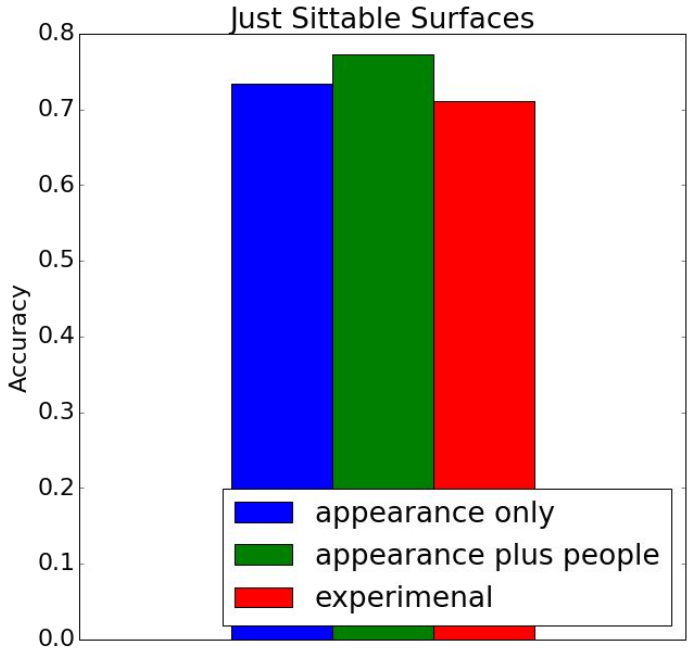


Experiment 4: Using sittable regions instead of standable regions

80 timelapses

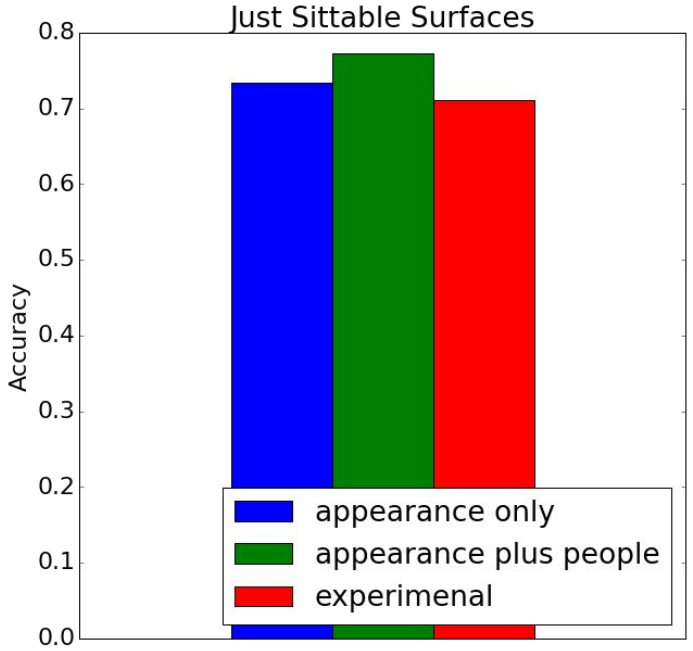


Experiment 4: Using sittable regions instead of standable regions

80 timelapses

Conclusion: Sittable regions tend to “push up” floor to avoid floating humans.

Misconception about the containment constraint!



Experiment 5: Relationship between detected floor space and actual floor space

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Hypothesis: Accuracy will suffer when there is high disparity between actual floor space and detected floor space

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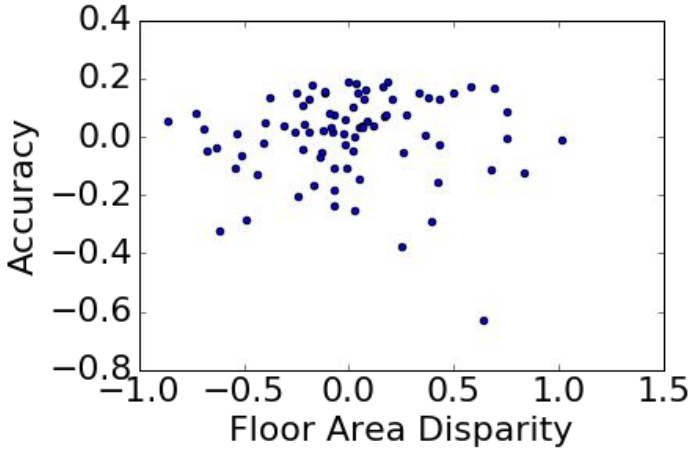


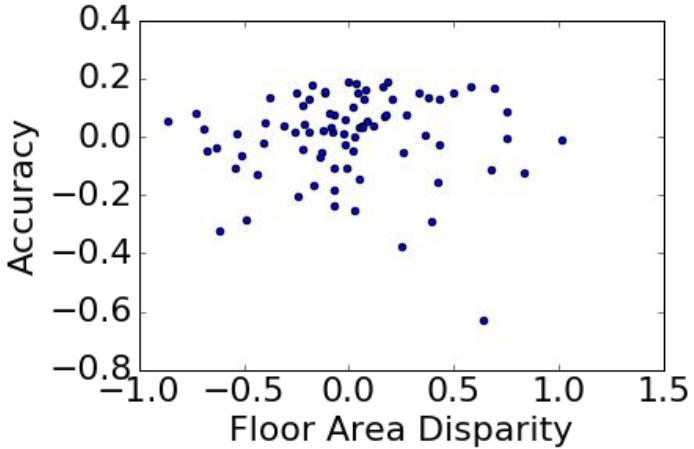
Experiment 5: Relationship between detected floor space and actual floor space

Hypothesis: Accuracy will suffer when there is high disparity between actual floor space and detected floor space

80 timelapses

Conclusion: The two are ***uncorrelated***!

Takeaway: ***Location*** of walkable area more important than magnitude



Computation Time Breakdown

- ~200-2000 room proposals per room
- ~7-20 seconds per room
- ~2 hours for 80 rooms