Localization in the Crowd with Topological Constraints

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INTRODUCTION

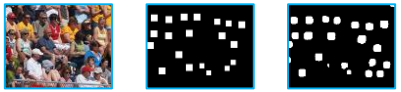
Crowd Localization:

Input Image + Groundtruth Dots

- Predicts the location of each person in a crowded scene.
- Explainable crowd counting.
- Extends to any dense population (animal, biological cells, etc.)
- Important for spatial analysis.

Challenges:

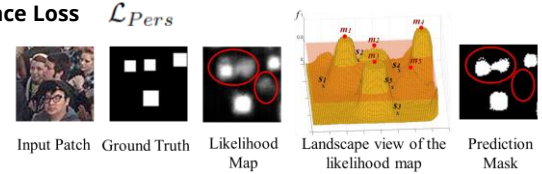
METHOD: TopoCount

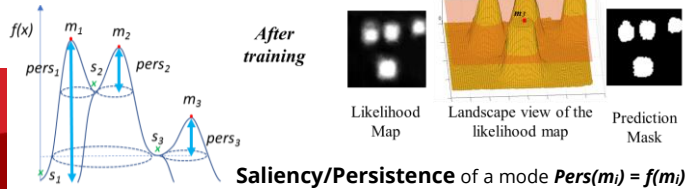


Topological Constraint for Crowd Localization

Within any local patch, the number of connected components in the prediction equals to the number of ground truth dots.

Persistence Loss $\mathcal{L}_{Pers}$



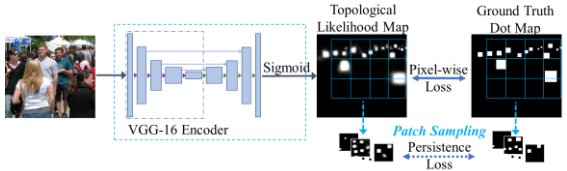


Saliency/Persistence of a mode ***Pers(mᵢ) = f(mᵢ) - f(sᵢ)***

Given a patch δ with c groundtruth dots, Mc top c salient modes, $\overline{Mc}$ other modes.

$\mathcal{L}_{Pers}$ *Reinforces the total saliency of the top c modes of f and suppresses the saliency of the rest:* $\mathcal{L}_{Pers}(f,\delta) = -\sum_{m\in\mathcal{M}_c} \mathrm{Pers}(m) + \sum_{m\in\overline{\mathcal{M}_c}} \mathrm{Pers}(m)$

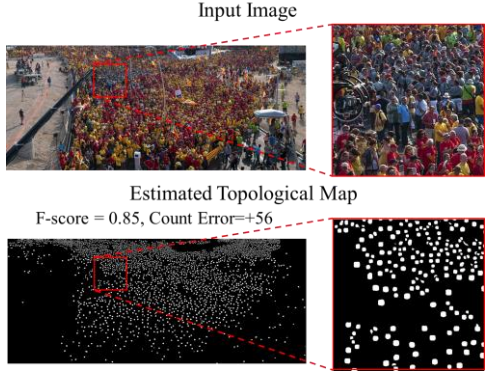
Model Architecture



EVALUATION

Dot Matching Accuracy

Method	F1 / Pre. / Rec. (%)
TinyFaces (Hu et al. 2017)	56.7 / 52.9 / 61.1
VGG+GPR (Gao et al. 2019)	52.5 / 55.8 / 49.6
RAZ Loc (Liu et al. 2019)	59.8 / 66.6 / 54.3
TopoCount	**69.1/ 69.5 / 68.7**



Contributions

> Formulate crowd localization as a structured prediction problem.

> Overcome crowd localization challenges by introducing topological constraints in the training phase.

> Propose persistence loss to enforce topological constraints.

> Achieve high quality localization that is useful for crowd counting and spatial analysis.

> *Paper and code:* https://github.com/TopoXLab/TopoCount