

Unifying Registration based Tracking: A Case Study with Structural Similarity Abhineet Singh, Mennatullah Siam and Martin Jagersand

Motivation

Online learning and detection based trackers are not suitable for tasks requiring **fast** and **high precision** tracking



- Progress in registration based tracking has become **fragmented**
- A principled way to relate these by decomposing the tracking task into three modules:

Search Method (SM), Appearance Model (AM) and State Space Model (SSM)

Contributions

- Provide a unifying formulation for registration based tracking
- Adapt a popular image quality measure called Structural Similarity for high DOF tracking
- simpler but faster version called **SPSS**
- Evaluate models comprehensively by comparing against 8 AMs using 11 SMs and 7 SSMs.
- Experiments are done using 4 large datasets with over **100K** frames
- Provide an open source tracking framework called MTF
- efficient C++ implementation
- experimental platform
- 14 SMs, 16 AMs and 10 SSMs currently implemented

Registration based Tracking



Decomposition





 $f_{spss} =$

 $E_{AL} = -$

Area overlap used in VOT does not capture rotations

Structural Similarity

 $(2\mu_t\mu_0 + C_1)(2\sigma_{t0} + C_2)$ $\overline{\left(\mu_t^2 + \mu_0^2 + C_1\right)\left(\sigma_t^2 + \sigma_0^2 + C_2\right)}$



Evaluation Alignment error (Full Pose)

$$\frac{1}{4} \sum_{k=1}^{4} \|\mathbf{c}_{k(track)} - \mathbf{c}_{k(gt)}\|$$





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Results