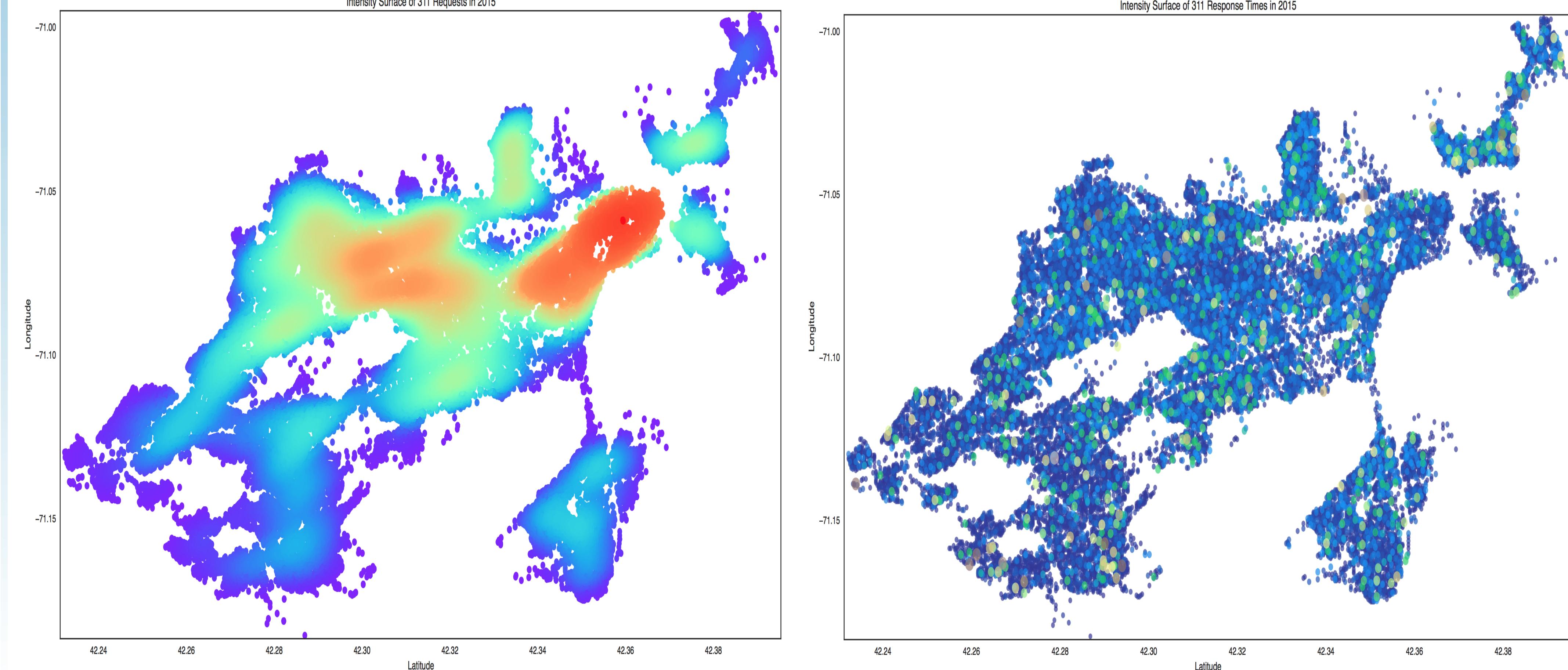
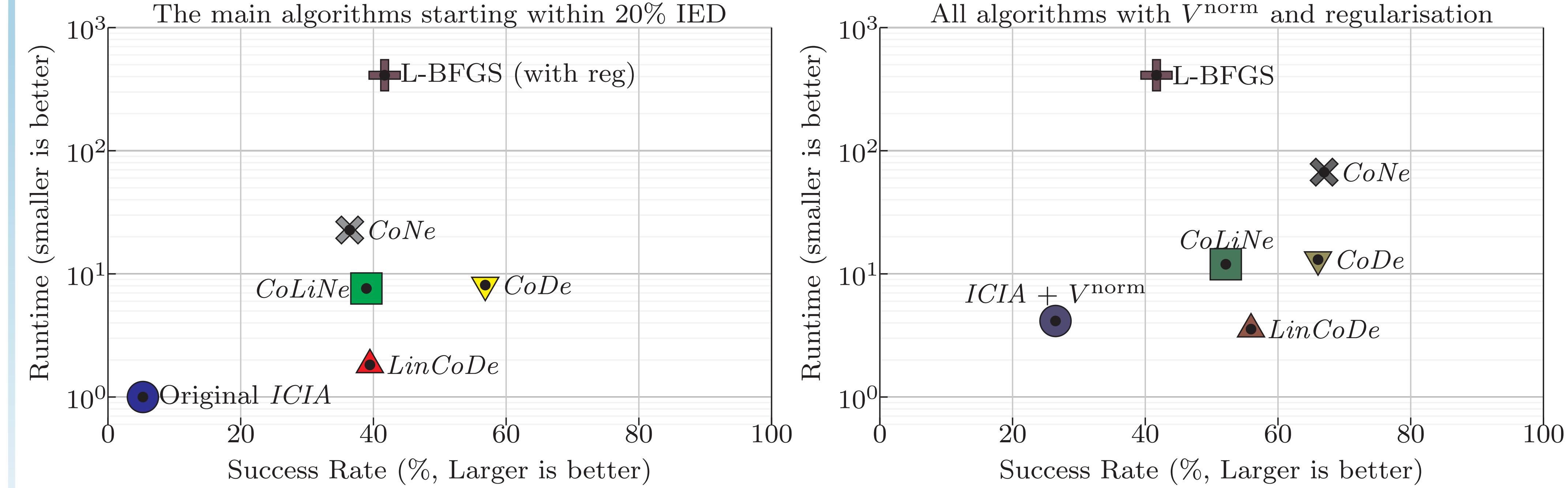


INTRODUCTION:

Inverse compositional image alignment (ICIA) is fast, but not reliable. We explain ICIA from a different perspective which leads naturally to two new algorithms with a better capture range and comparable speed.

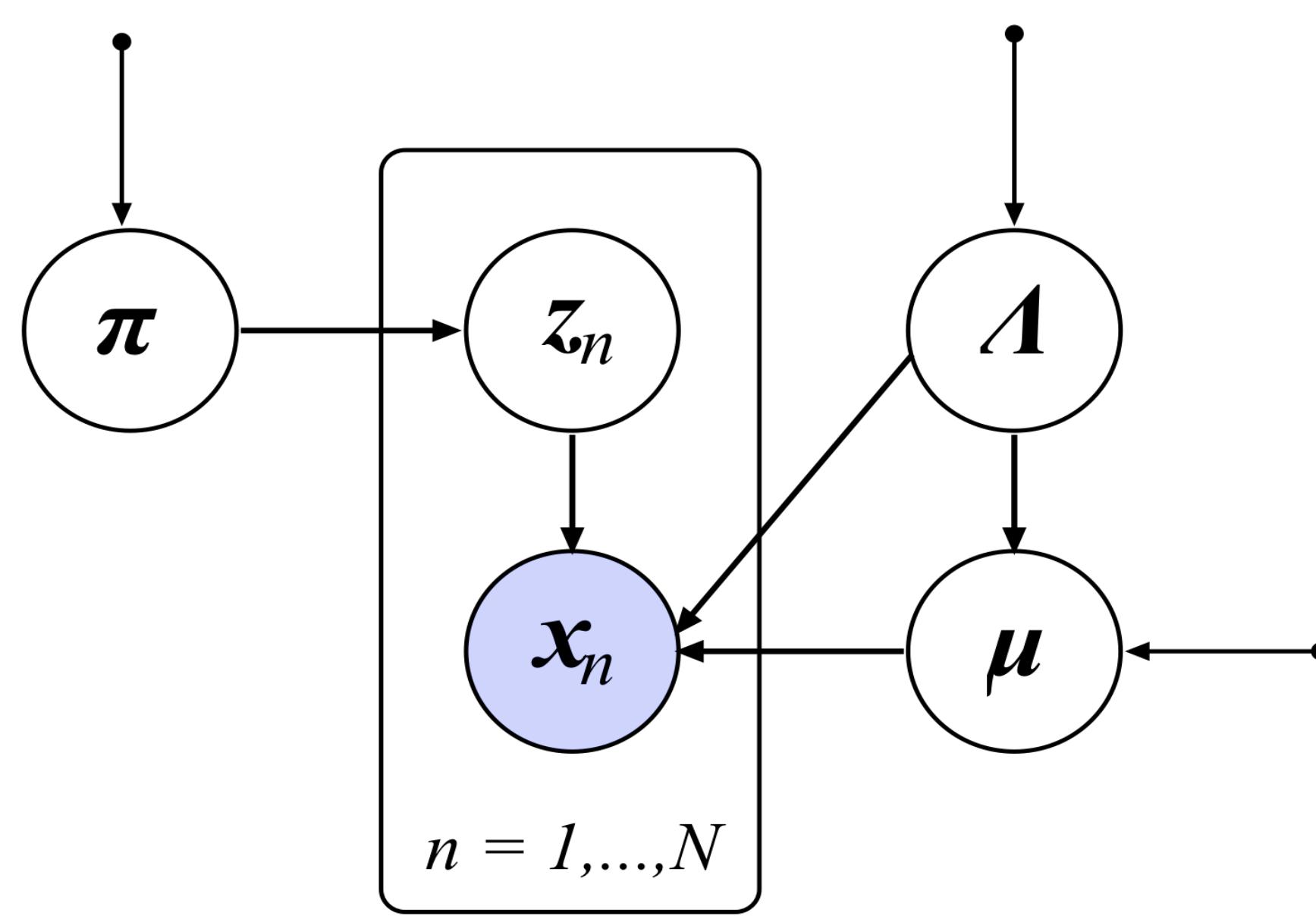


LATENT CLASSES IN 311 DATA



Fitting a multiperson AAM. The best speed–performance tradeoffs come from the two new algorithms *CoDe* and *LinCoDe*. Note that *ICIA* is practically useless on this difficult multi-person dataset with a success rate near zero (left). It can be improved (right) by using the orthonormal incremental warp and regularisation. The *CoDe* algorithm with regularisation (right) is as accurate as the slow, approximation-free, compositional Gauss–Newton *CoNe* method but is seven times more efficient.

THE MODEL

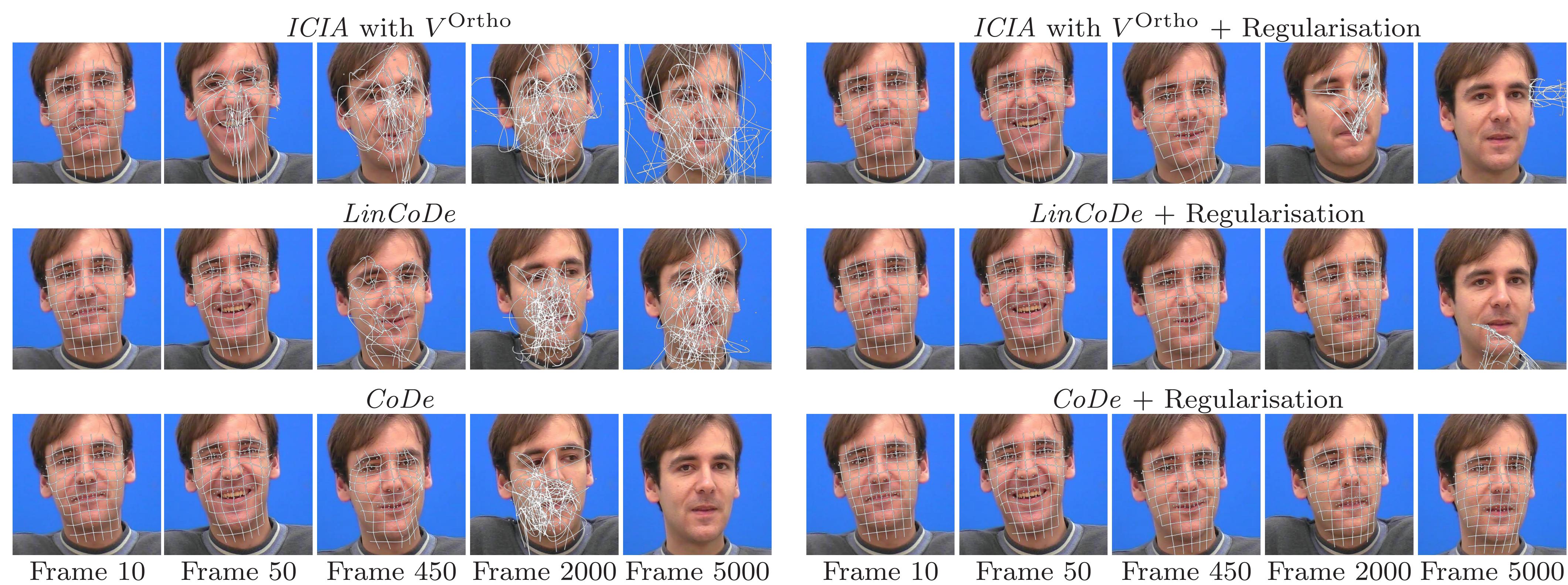


INFERENCE

```

for Blur and regularisation values do
1   Initialize  $q$ ,  $q_{best}$  and  $\kappa$ 
repeat
2   Calculate  $\nabla_p \tilde{F}(q, 0)$ ,  $F(q)$ 
3   if  $F(q) < F(q_{best})$  then
4      $q_{best} \leftarrow q$ 
      Increase  $\kappa$ 
    else
      if  $\kappa$  smaller than threshold then
        return
        decrease  $\kappa$ 
      end
    end
5   Calculate  $p$  from  $\nabla_p \tilde{F}(q_{best}, p)$  and  $\kappa$ 
6    $q \leftarrow C^\circ(q, p)$ 
until converged
7
  
```

VISUALIZATION



Our algorithm makes fast and robust tracking possible. We compare face tracking under natural motion, using *ICIA*, *LinCoDe* and *CoDe*. The original *ICIA* fails immediately with this large model and new face data. Substituting the orthonormal incremental warp for the original *ICIA* warp, the algorithm still loses track very early, whereas *LinCoDe* and *CoDe* can track much further. Finally, adding regularisation to all algorithms, *ICIA* still loses track completely after approximately 500 frames and does not recover the local deformations accurately. In contrast *CoDe* now tracks the full 5000 frame sequence without reinitialization, and *LinCoDe* tracks for 2500 frames.

The same training dataset was used for both tracking experiments. The training data was acquired with different camera and light settings from different subjects.