

## Q2

### 2.1

1 按此文的分类,光流法可分为哪几类?

We categorize algorithms as either additive or compositional, and as either forwards or inverse.

The difference between additive approach and compositional approach:  
One difference between the various approaches is whether they estimate an additive increment to the parameters (the *additive* approach (Lucas and Kanade, 1981)), or whether they estimate an incremental warp that is then composed with the current estimate of the warp (the *compositional* approach (Shum and Szeliski, 2000))

2 在 compositional 中,为什么有时候需要做原始图像的 wrap?该 wrap 有何物理意义?

The compositional approach iteratively solves for an incremental warp  $\mathbf{W}(\mathbf{x}; \mathbf{p})$  rather than an additive update to the parameters  $\Delta \mathbf{p}$ .

The warp is updated  $\mathbf{W}(\mathbf{x}; \mathbf{p}) \leftarrow \mathbf{W}(\mathbf{x}; \mathbf{p}) \circ \mathbf{W}(\mathbf{x}; \mathbf{p})$ .

The Jacobian can be pre-computed because it is evaluated at  $(\mathbf{x}; \mathbf{0})$

Instead of simply adding the additive updates  $\mathbf{p}$  to the current estimate of the parameters  $\mathbf{p}$  as in the Lucas-Kanade algorithm, the incremental update to the warp  $\mathbf{W}(\mathbf{x}; \mathbf{p})$  must be composed with the current estimate of the warp  $\mathbf{W}(\mathbf{x}; \mathbf{p})$  in the compositional algorithm. This operation typically involves multiplying two matrices to compute the parameters of the composed warp.

### 3 Forward 和 inverse 有何差别?

Inverse: uses constant Hessian Matrix which can be precomputed and the reused.

The differences between the forwards and inverse compositional algorithms are

- a. The error image is computed after switching the roles of I and T
- b. Inverse method uses the gradient of T rather than the gradient of I and can be precomputed.
- c. The incremental warp is inverted before it is composed with the current estimate.

## 2.2

见代码

## 2.3

见代码

## 2.4

见代码

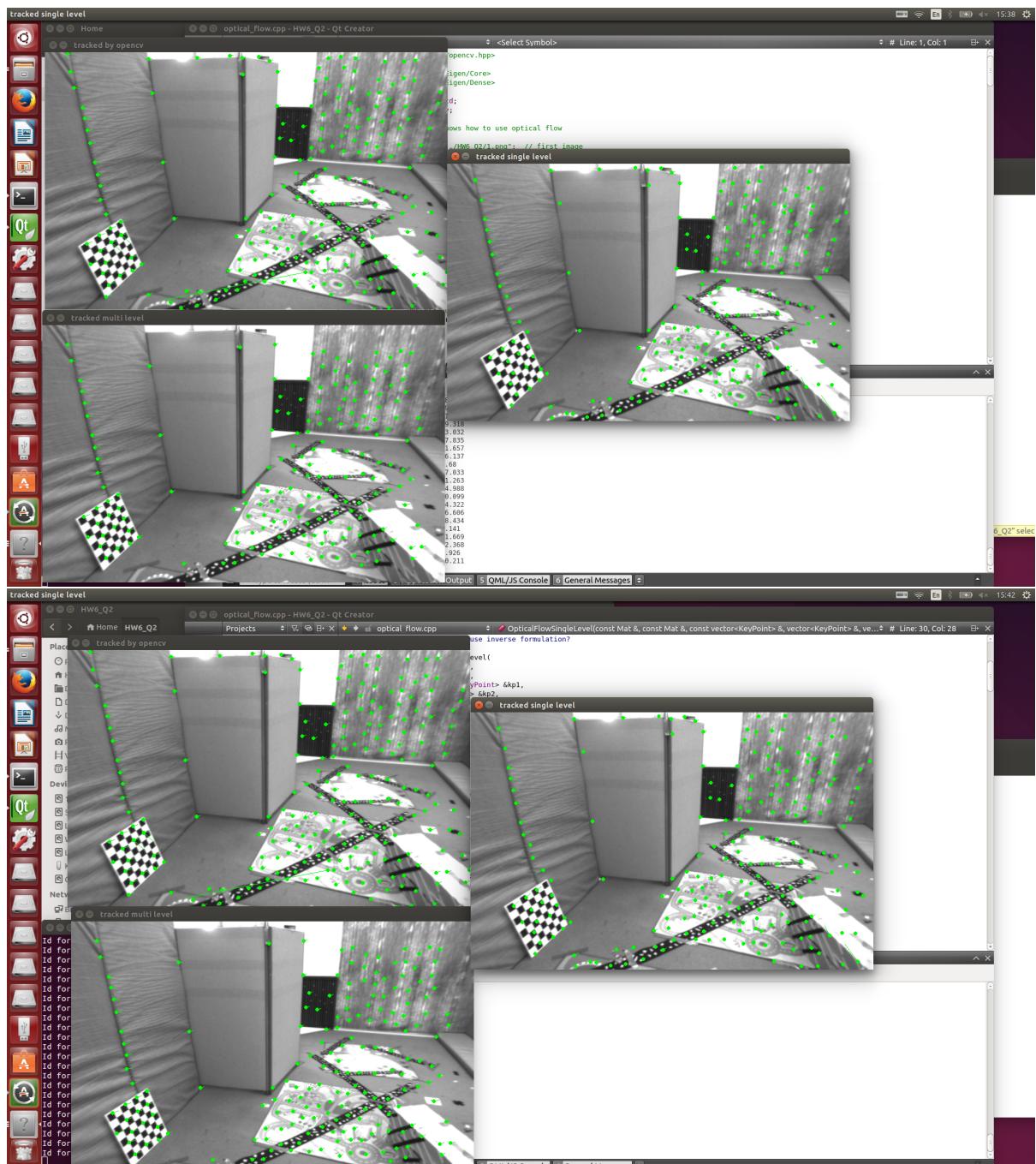
### 1. Coarse-to-fine

对原图像进行缩放, 在最小的图像上先追踪光流, 得到一个估计后投影到下一层图像上去(用上一层的估计作为下一层的初始值), 然后再在当前层追踪光流, 以此类推 直到在原始大小的图像上追踪到光流

(即 现在粗糙的小图像上找一个粗略点, 当分辨率提高的时候, 再从这个粗略点出发进行新的估计, 一层一层往下, 直到追踪到原始图像上去)

2. 特征点法中用金字塔是因为有些点在缩略图中是角点, 而在放大的分辨率高的图中就不是角点, 采用金字塔可以保证尺度不变性, 保证了不管原图像尺度是多少, 在包含了所有尺度的尺度空间都能找到那些稳定的极值点

## Result



Q3

3.1

1.误差项是图一中某个点处的灰度与图二中估计的位置处的灰度差

这里在图一中的点和图二中对应点附近都取了图像块，相应的小块——进行灰度的比较

2.

投影方程关于位姿的导数是 2x6

图像在  $u$  处的梯度为  $1 \times 2$

所以误差对于自变量的雅克比是六维, 求解见代码

3.

理论上窗口小精度越高,但是窗口取的过小比如去一个单个点不鲁棒

## Result



Q4

