Observer motion problem

velocity field

From image velocity field, compute:

- observer translation

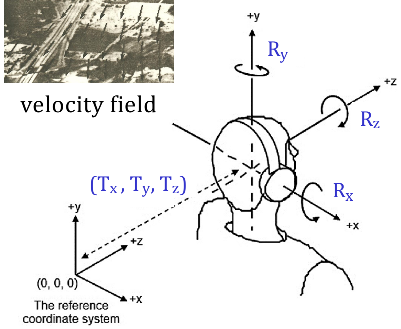
  $(T_x\ T_y\ T_z)$

- observer rotation

  $(R_x\ R_y\ R_z)$

- depth at each location

  $Z(x, y)$



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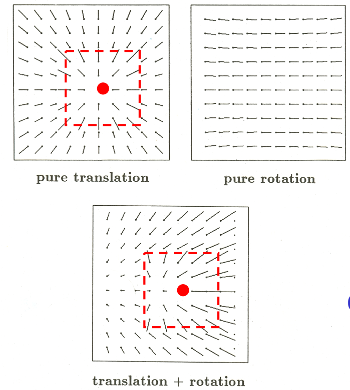
Observer motion problem, revisited



From image motion, compute:

- Observer translation

  $(T_x\ T_y\ T_z)$

- Observer rotation

  $(R_x\ R_y\ R_z)$

- Depth at each location

  Z(x,y)

Observer undergoes ***both*** translation + rotation

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Equations of observer motion

Translation	Rotation	Depth
(T_x, T_y, T_z)	(R_x, R_y, R_z)	$Z(x,y)$

$$V_x = (-T_x + xT_z)/Z + R_x xy - R_y(x^2+1) + R_z y$$

$$V_y = (-T_y + yT_z)/Z + R_x(y^2+1) - R_y xy - R_z x$$

Translational Component: $(-T_x + xT_z)/Z$, $(-T_y + yT_z)/Z$

Rotational Component: $R_x xy - R_y(x^2+1) + R_z y$, $R_x(y^2+1) - R_y xy - R_z x$

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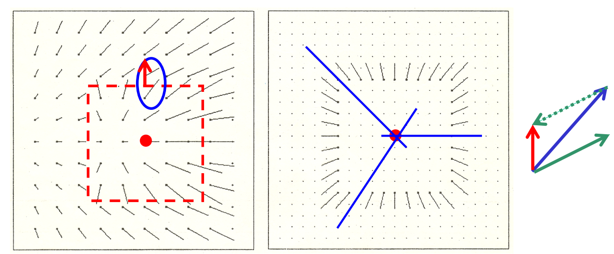
Longuet-Higgins & Prazdny



- Along a depth discontinuity, *velocity differences* depend only on observer translation
- Velocity differences point to the focus of expansion

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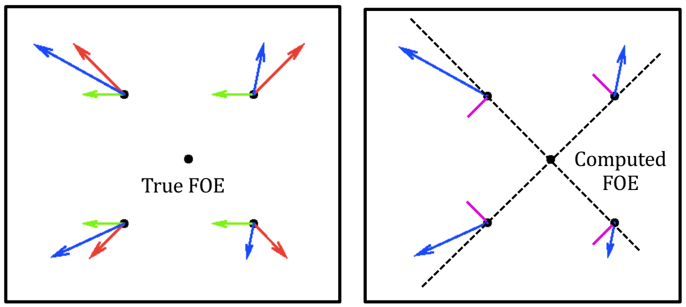
Recovering the observer's rotation



Velocity component due to observer's translation
Velocity component due to observer's rotation
Final velocity at each location

Computed FOE → *translational field lines*

Velocity perpendicular to field lines must be due to observer's rotation!

Find (R_x, R_y, R_z) that ***best explains*** the motion perpendicular to the field lines

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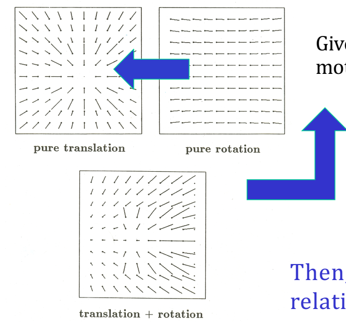
Finally, recovering 3D layout



Given (R_x, R_y, R_z), compute image motions due to rotation…

… then subtract motions due to rotation, to obtain the image motions due to the observer's translation alone

Then, how can we compute the relative depth of surfaces?

What are we assuming about objects in the scene?

When is this assumption violated?

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