Epipolar geometry:

* Says that given a straight-line preserving transformation (Basically all of Rot, Trans, Scale, Similarity, Affine & Proj) search space for the corresponding point of a given point in an image from the other image goes from the entire image (2D) to a line (1D)
  - Gives advantages in terms of both faster computation and also lesser false associations with objects having similar features (obtained from descriptors or other methods)

* Epipolar axis – Line joining projection centers

Epipolar plane – Plane spanned by projection centers and point being observed.

Epipole – Projection of the camera center of the other camera onto the image

Epipolar line – Intersection of the epipolar plane with the image plane – We get the line

* Varying the distance of the point wrt one camera keeping the direction same, the image pixel location of that point slides on the epipolar line corresponding to the other camera

Hence, the search space reduces to the epipolar line

* It is called the epipolar axis because you can generate the epipolar plane that passes through another point by just rotating it about this axis

* Epipolar lines: Images of the rays joining the point being observed and the camera center onto the image plane of the other camera

* Epipoles also lie on the epipolar plane because they lie on the epipolar axis, which lies on the plane. Essentially, these epipoles are the intersections of the epipolar axis with the image planes

(*) If a point x lies on a line l, then $x^T l = 0$

(*) If x' and x'' are the corresponding image locations, then from coplanarity constraints, we have

$\boxed{x'^T F x'' = 0} \Rightarrow \boxed{x''^T F^T x' = 0}$

$\Rightarrow$ For x', the epipolar line is $\boxed{l' = F x''} \rightarrow x'^T l' = 0$

For x'', the epipolar line is $\boxed{l'' = F^T x'} \Rightarrow x''^T l'' = 0$

(*) Epipoles are just projections of camera centers onto the other image planes

$\Rightarrow \boxed{e' = P' X_{0''}}$ and $\boxed{e'' = P'' X_{0'}}$

(*) These points lie on all epipolar lines

$\Rightarrow \boxed{e'^T l' = 0}$ and $\boxed{e''^T l'' = 0}$

$\Rightarrow \boxed{e'^T F x'' = 0}$ and $\boxed{e''^T F^T x' = 0}$

$\Rightarrow$ $\boxed{e' \text{ is null space of } F^T}$ and $\boxed{e'' \text{ is null space of } F}$

$[\because F^T e' = 0]$ $[\because F e'' = 0]$

$\Rightarrow \boxed{e'^T F = 0}$ and $\boxed{F e'' = 0}$