A simple prior free method for non-rigid structure-from-motion Factorization

**About:**

* This paper can recover both camera motion and non-rigid shape accurately without any ambiguity.
* The paper discusses about the factorisation problem of measurement matrix and techniques employed to accurately extract non-rigid shape and camera motion.
* The paper does not assume any constraints on non-rigid shape, scene , camera motion etc…..

**Discussion:**

* Tomasi and Kanade proposed a factorisation techniques from rigid bodies and orthographic projections.
* Bregler’s paper on non-rigid shapes from Image streams discusses a technique on recovering 3-D models from 2-D sequences recorded with a single camera.
* The big success of this paper is that a 3-D non rigid shape can be recovered from single view without a-priori models.
* Next a paper by Jing Xiao on a closed from solution to Non-rigid shape and Motion recovery argues that enforcing only the rotation constraints leads to ambiguous and invalid solutions
* To explain the above statement , it means that when we also introduce basis constraints in addition to rotation constraints we can uniquely determine the basis shapes.
* The paper argues that non-linear optimization is what makes good 3-D constructions .This paper provides optimal solution to structure from motion factorization problem.
* Measurement matrix W = R S = π’B’ = π’GG`B’ . where R is rotation matrix .S is non-rigid shape. S is assumed to be linear combination of base shapes and rank of w <= 3\*k;
* The π and B found from SVD are determined upto 3k\*3k linear transformation. The main problem is finding the gram matrix G such that π’ is rectified to Euclidean form π = π’G and B=G`B`.
* According to xio et al theorem Gram matrix Qk = GG` solutions are subspace of dimension 2k2 – k.
* The centralised theorem of the paper says that any correct solution of Qk must be intersection of the 2k2 – k null space of matrix A and rank 3 PSD matrix .
* The above finally reduces to min trace (Q*k*) *,* such that*,* Q*k >\_* 0*,* A vec(Q*k*) = **0***.* The author says that this is standard SDP problem of fixed size 2k2 – k and can be solved easily.
* The next steps are finding rotation and non-rigid shape matrix S.
* R = blkdiag(R1,R2,…..Rk) where each Rj can be calculated from 2\*I and 2\*i-1 th rows of π` found from svd multiplied with Gk.
* Solving s is the rank minimisation problem: find min-rank(s) such that W = RS . S = R`W where R` is the pseudo-inverse of R.