

MOTION ESTIMATION AND DEBLURRING OF FAST MOVING OBJECTS



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PROBLEM

Objective: Single-frame blind motion deblurring and precise motion estimation of objects moving over static background

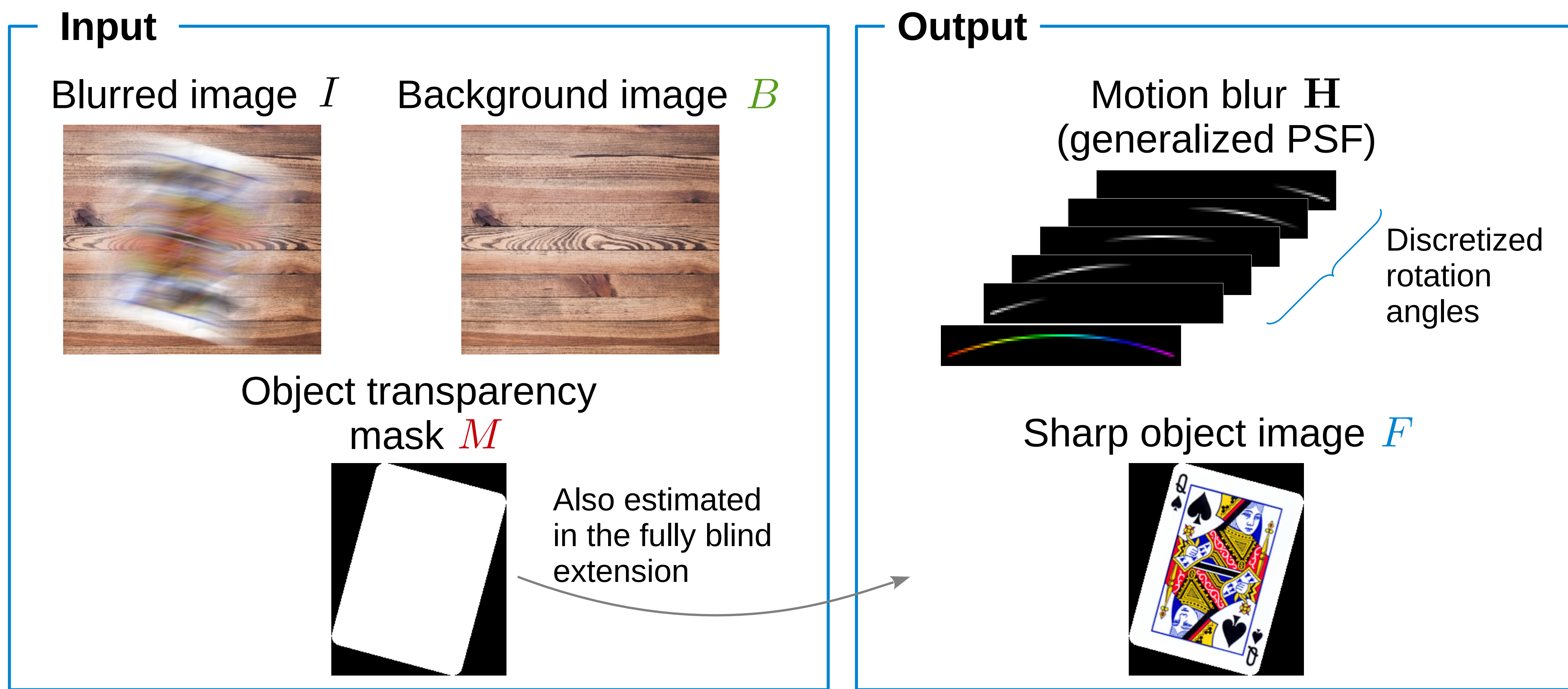
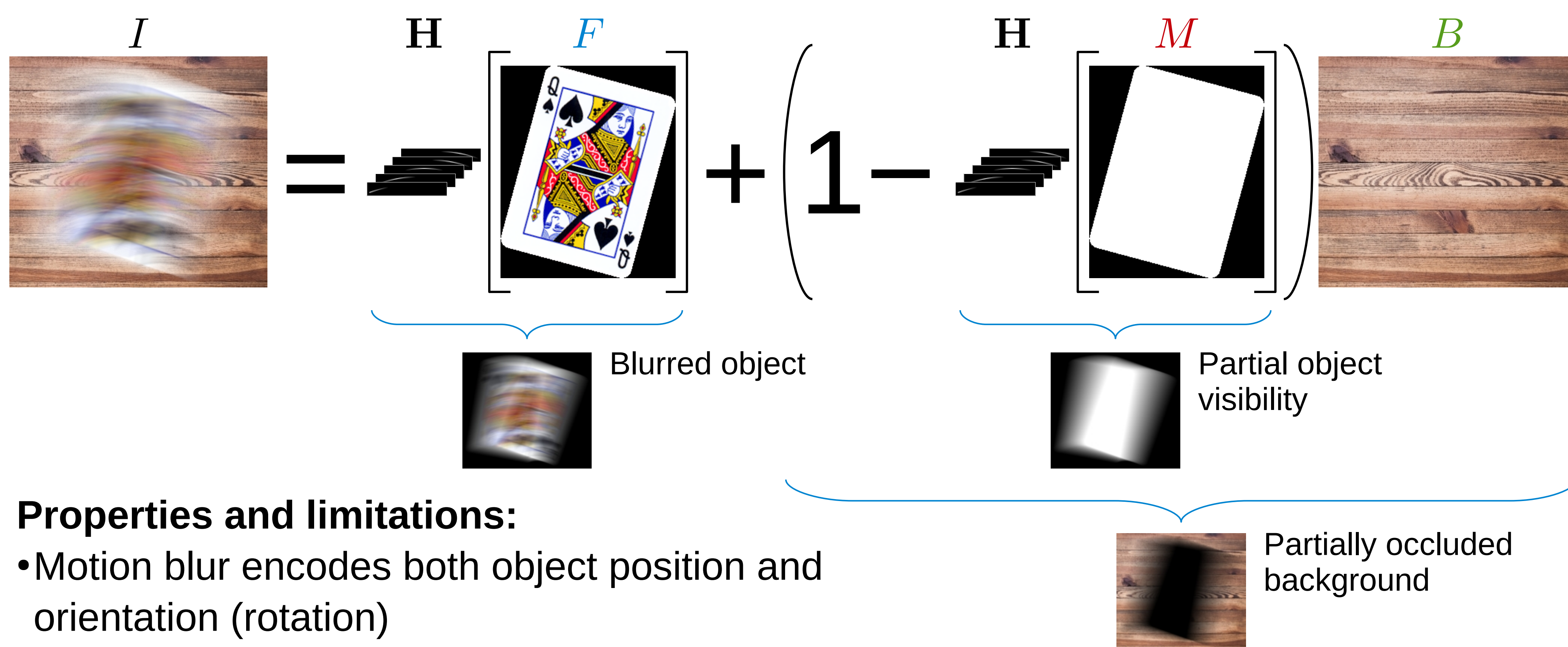


Image acquisition model: $I = H[F] + (1 - H[M]) \cdot B$



Properties and limitations:

- Motion blur encodes both object position and orientation (rotation)
- Currently limited to 2D in-plane rotation and lateral motion
- Extensions: 1) Fully blind estimation of the object shape, 2) 3D rotation of spherical objects (see examples on the right)

SOLUTION

Optimization problem:
$$\min_{F, H} \|H[F] + (1 - H[M]) \cdot B - I\|_2^2 + \alpha \|\nabla F\|_1 + \beta \|H\|_1$$

 s.t. $F \in [0, 1]$ and $H \geq 0$

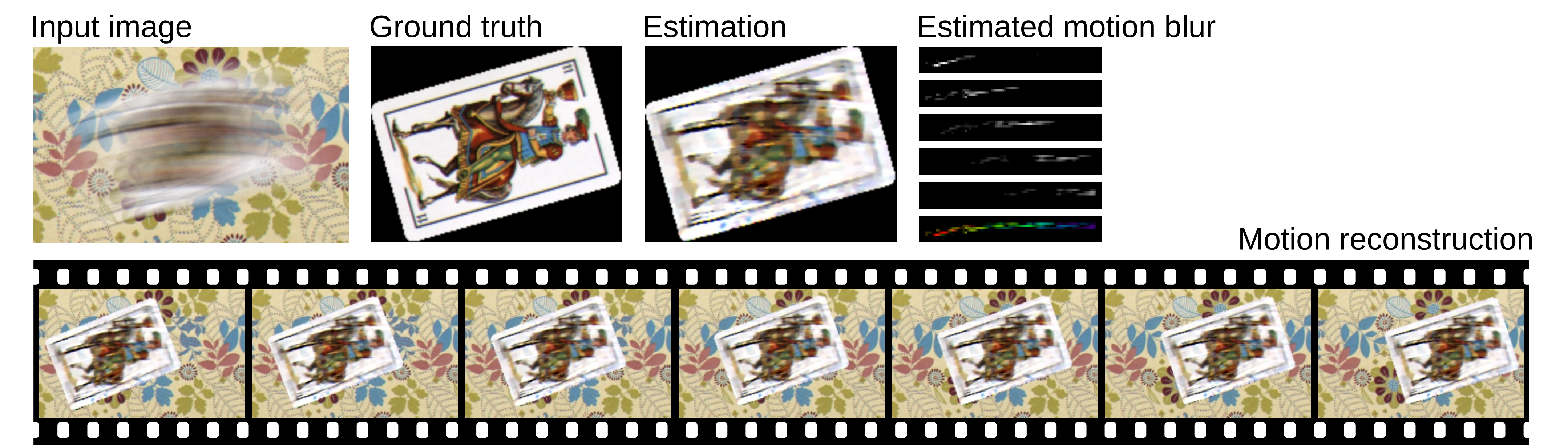
Alternating minimization using ADMM:

F - estimation: $(H^T H + \rho \nabla^T \nabla) [F] = H^T [B \cdot H[M] + (I - B)] + \rho \nabla^T (z_1 - u_1)$

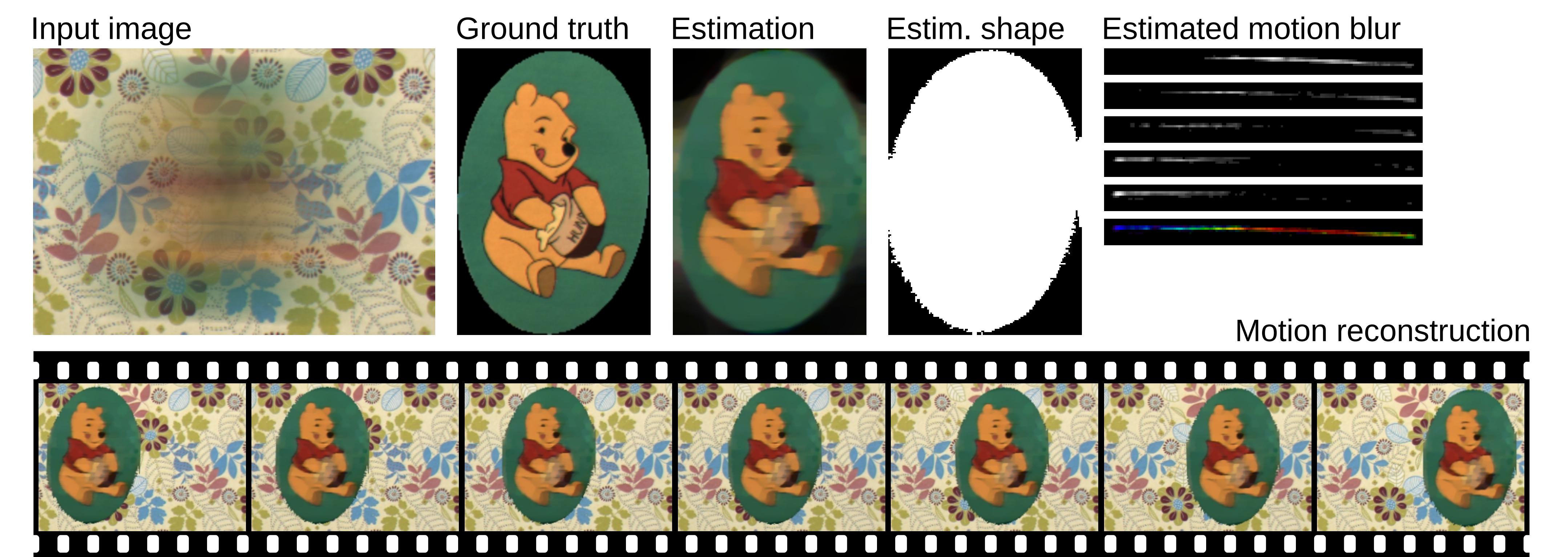
H - estimation: $((F - BM)^T (F - BM) + \rho I) [H] = (F - BM)^T [I - B] + \rho (z_2 - u_2)$

RESULTS

Object appearance estimation:



Object appearance and shape estimation (fully blind extension):



Object appearance of spherical objects (3D rotation extension):

