Berechnung der essentiellen Matrix

1) Intrinsische Matrizen, die von MATLAB ausgegeben wurden, transponieren

Linke: $\begin{bmatrix} 2936{,}0146 & 0 & 911{,}4241 \\ 0 & 2939{,}5803 & 673{,}3906 \\ 0 & 0 & 1 \end{bmatrix}$

Rechte : $\begin{bmatrix} 4663{,}1058 & 0 & 960{,}8538 \\ 0 & 4664{,}9718 & 665{,}5394 \\ 0 & 0 & 1 \end{bmatrix}$

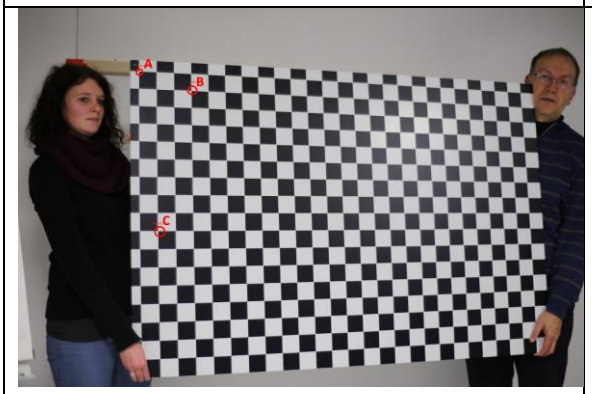
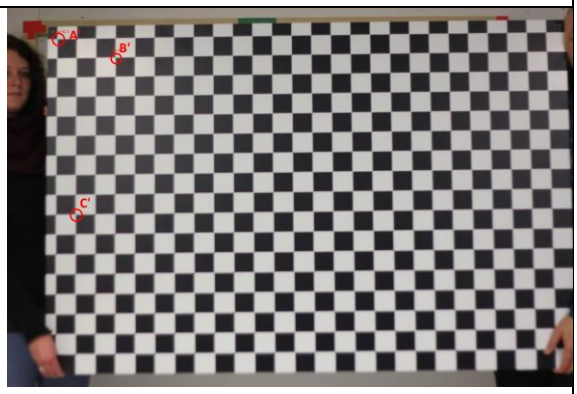
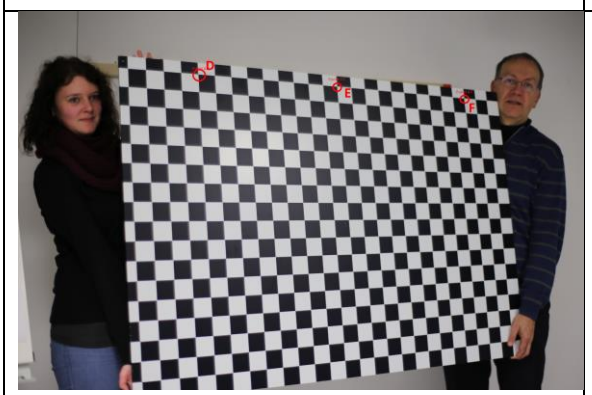
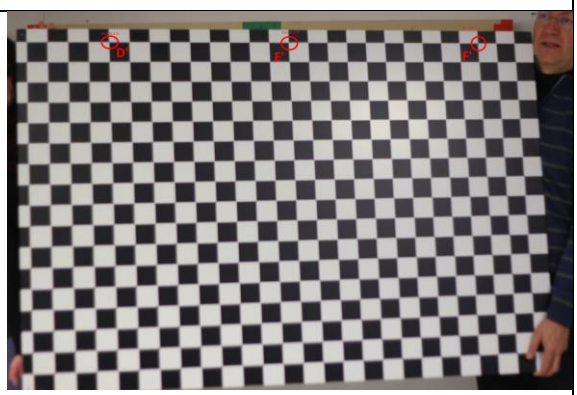
2) Dann in mm umrechnen. Wir erhalten K' (rechts) bzw. K (links)

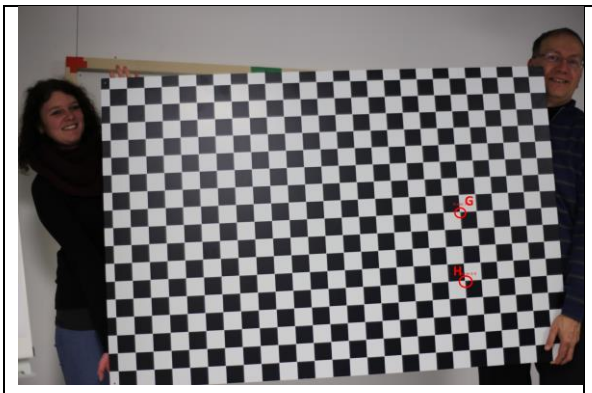
K = $\begin{bmatrix} 19{,}084 & 0 & 5{,}924 \\ 0 & 19{,}107 & 4{,}377 \\ 0 & 0 & 1 \end{bmatrix}$

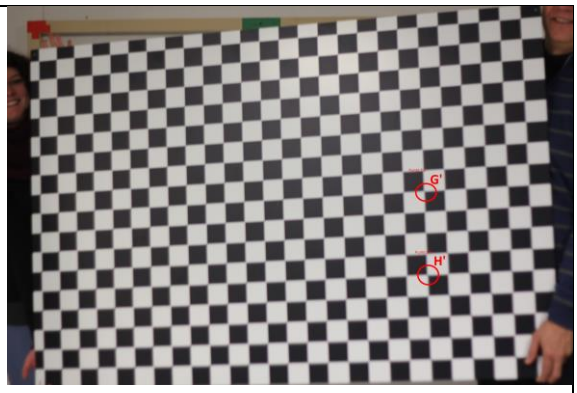
K‘ = $\begin{bmatrix} 20{,}004 & 0 & 4{,}122 \\ 0 & 20{,}012 & 2{,}855 \\ 0 & 0 & 1 \end{bmatrix}$

3) Dann: E = K'^(T) F K

1. Schritt: Bestimmung der Punkte A – H

Linke Kamera	Rechte Kamera
	
	





Die ermittelten Pixel Koordinaten aus den Bildern:

Hinweis: Der Nullpunkt (0,0) befindet sich oben links vom Bild

A = [409; 214; 1]	A_ = [170; 105; 1]
B = [586; 280; 1]	B_ = [367; 167; 1]
C = [474; 753; 1]	C_ = [232; 697; 1]
D = [609; 214; 1]	D_ = [345; 105; 1]
E = [1078; 255; 1]	E_ = [953; 106; 1]
F = [1508; 295; 1]	F_ = [1592; 109; 1]
G = [1493; 696; 1]	G_ = [1410; 626; 1]
H = [1510; 928; 1]	H_ = [1421; 909; 1]

Die ermittelten Pixel Koordinaten in mm umgerechnet

Hinweis: Die Pixelkoordinaten wurden mit dem jeweiligen Pixel Pitch der Kamera (linke: 6.5µm, rechts: 4.29µm) verrechnet:

A = [2.6585; 1.391; 1]	A_ = [0.7293; 0.4505; 1]
B = [3.809; 1.820; 1]	B_ = [1.5744; 0.7164; 1]
C = [3.081; 4.8945; 1]	C_ = [0.9953;2.9901; 1]
D = [3.958; 1.391;1]	D_ = [1.480; 0.4505; 1]
E = [7.007; 1.6575; 1]	E_ = [4.0884; 0.4547; 1]
F = [9.802; 1.9175;1]	F_ = [6.8297; 0.4676;1]
G = [9.7045; 4.526; 1]	G_ = [6.0489; 2.6855;1]
H = [9.815; 6.032;1]	H_ = [6.0961; 3.8996; 1]

2. **Schritt:** Bestimmung der Fundamentalmatrix

```
Funda = [
A_(1) * A(1), A_(1) * A(2), A_(1), A_(2) * A(1), A_(2) * A(2), A_(2), A(1), A(2), 1;
B_(1) * B(1), B_(1) * B(2), B_(1), B_(2) * B(1), B_(2) * B(2), B_(2), B(1), B(2), 1;
C_(1) * C(1), C_(1) * C(2), C_(1), C_(2) * C(1), C_(2) * C(2), C_(2), C(1), C(2), 1;
D_(1) * D(1), D_(1) * D(2), D_(1), D_(2) * D(1), D_(2) * D(2), D_(2), D(1), D(2), 1;
E_(1) * E(1), E_(1) * E(2), E_(1), E_(2) * E(1), E_(2) * E(2), E_(2), E(1), E(2), 1;
F_(1) * F(1), F_(1) * F(2), F_(1), F_(2) * F(1), F_(2) * F(2), F_(2), F(1), F(2), 1;
G_(1) * G(1), G_(1) * G(2), G_(1), G_(2) * G(1), G_(2) * G(2), G_(2), G(1), G(2), 1;
H_(1) * H(1), H_(1) * H(2), H_(1), H_(2) * H(1), H_(2) * H(2), H_(2), H(1), H(2), 1;

];

Funda = null(Funda);

Funda =
```

```
    0.0009
   -0.0602
    0.2911
    0.0469
   -0.0018
    0.5952
   -0.1435
   -0.4704
    0.5598
```

```
Funda = [
0.0009, -0.0602, 0.2911;
0.0469, -0.0018, 0.5952;
-0.1435, -0.4704, 0.5598
];
```

3. Schritt: E = K'^(T) F K

```
K = [
19.084, 0, 5.924;
0, 19.107, 4.377;
0, 0, 1
]
```

```
K_ = [
20.004, 0, 4.122;
0, 20.012, 2.855;
0, 0, 1
]

// Essential Matrix
Essential = K_' * Funda * K

Essential =

    0.3436  -23.0094    0.6589
   17.9115   -0.6883   17.3135
   -0.1124  -13.8274    0.2566
```

4) Dann Singulärwertzerlegung von E

```
[U, S, V] = svd(Essential)

U =

    0.8195   -0.2508   -0.5153
    0.2991    0.9542    0.0112
    0.4889   -0.1634    0.8569

S =

   27.0569         0         0
   0          24.7028         0
   0          0          0.1040

V =

    0.2064    0.6891   -0.6947
   -0.9543    0.2985    0.0125
    0.2160    0.6604    0.7192
```