BLOCK DEPENDENT DICTIONARY BASED DISPARITY COMPENSATION FOR STEREO IMAGE CODING

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Outline

I. Problem Statement :

Disparity Compensated Based Stereoscopic Image Coding

II. Main Contribution :

Building a Block Dependent Dictionary

III. Results and Conclusion :

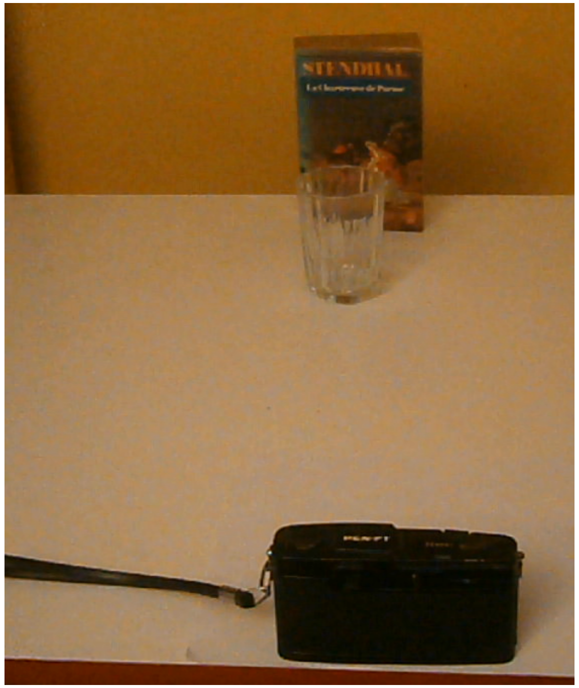
Slightly Better Performance than Block Matching and Independant Coding,

Increased Numerical Complexity

I.1 Stereoscopic Image

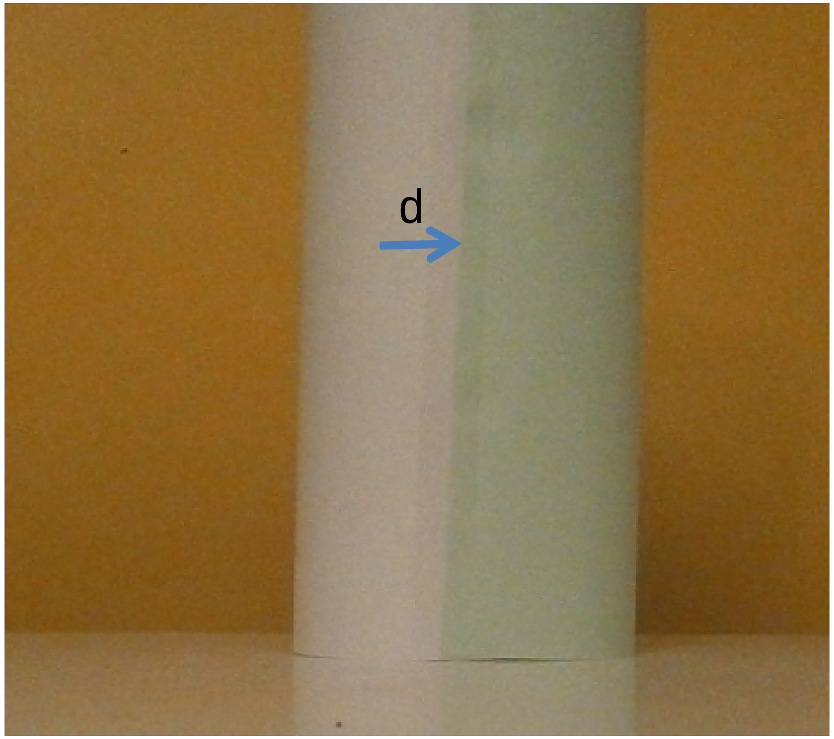
I^l: left view
I^r: right view
d: disparity
m,n: pixel location

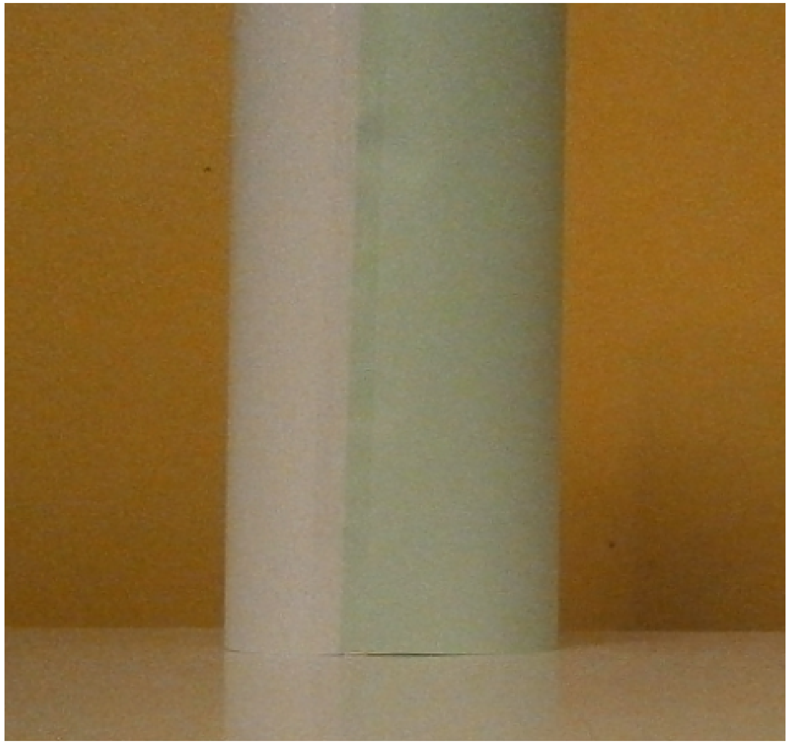
$$I^r(m,n) \approx I^l(m,n+d)$$



I.2 True Disparity Vs Pseudo-Disparity

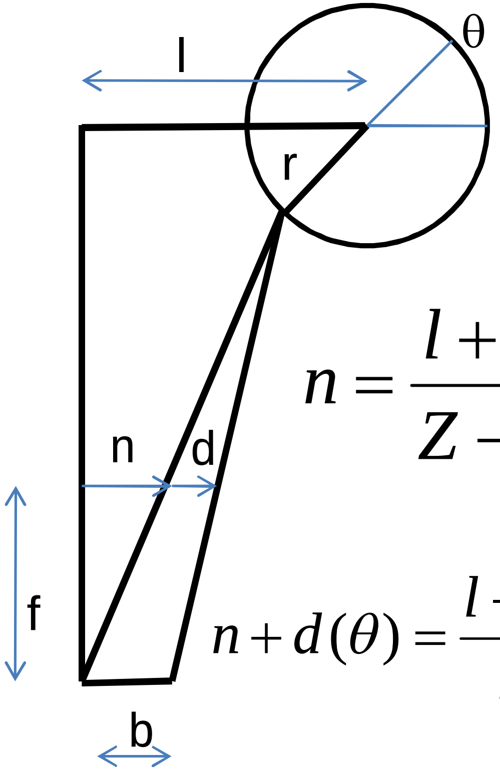
Predicting with pseudo-disparity





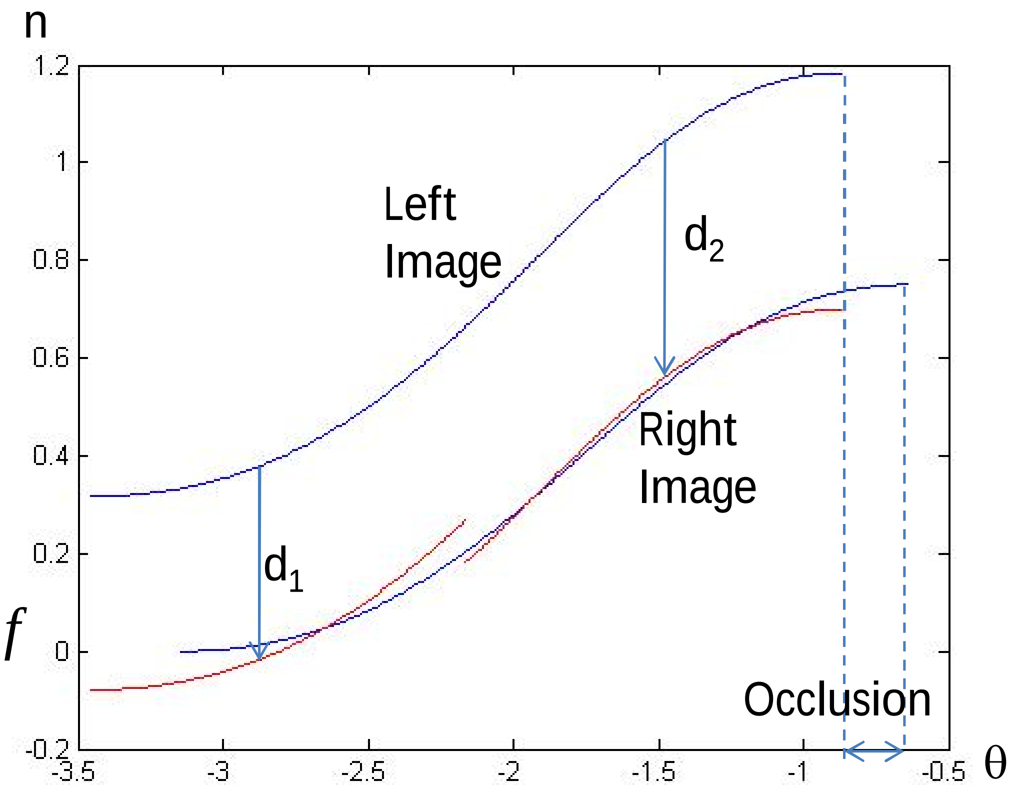
I.3 True Disparity Vs Pseudo-Disparity

Example showing how complex the true disparity can be.



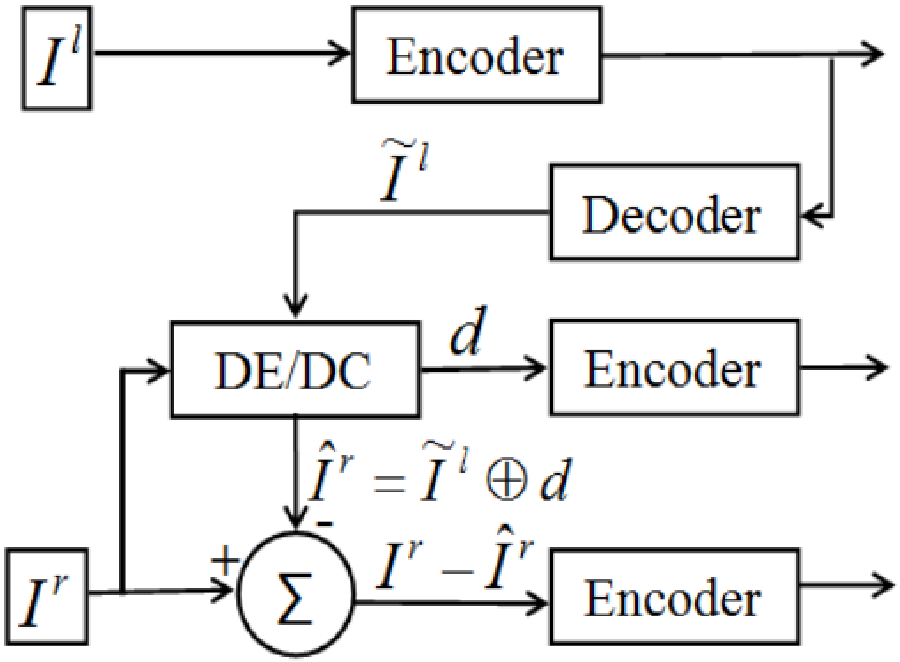
$$n = \frac{l + r\cos\theta}{Z - r\sin\theta} f$$

$$n + d(\theta) = \frac{l - b + r\cos\theta}{Z - r\sin\theta} f$$

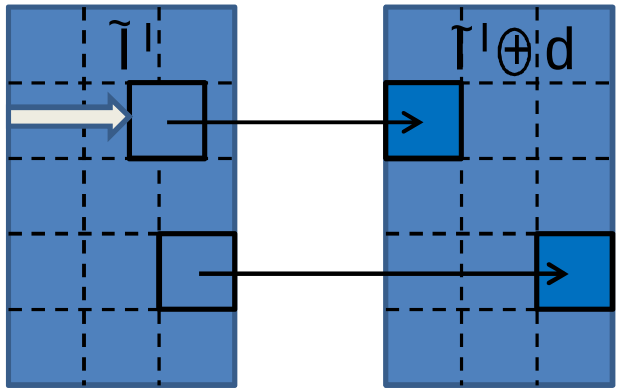


I.4 Disparity-Compensated Based Stereo Image Coding

Standard closed-loop-based stereo coding scheme



Disparity compensated image



II.1 Using a Block Dependent Dictionary

Encoding process

1. For each block,

   a. build a specific dictionary of possible reconstructions
   b. select the index s yielding best reconstruction

2. Arithmetic encoding of all indexes s

Decoding process

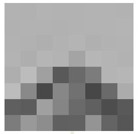
1. Arithmetic decoding of all indexes s

2. For each block,

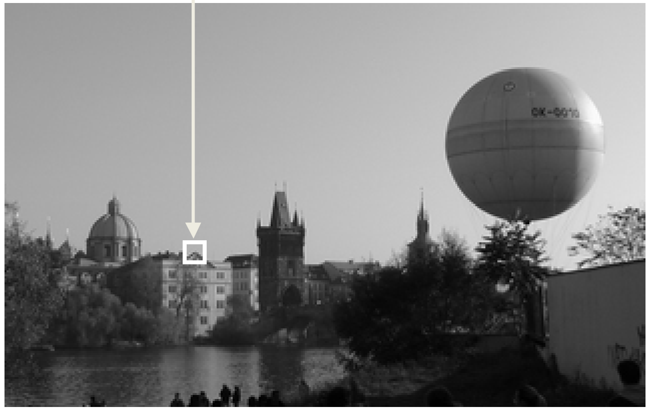
   a. build the same specific dictionary of possible reconstructions
   b. Predicting the block using index s

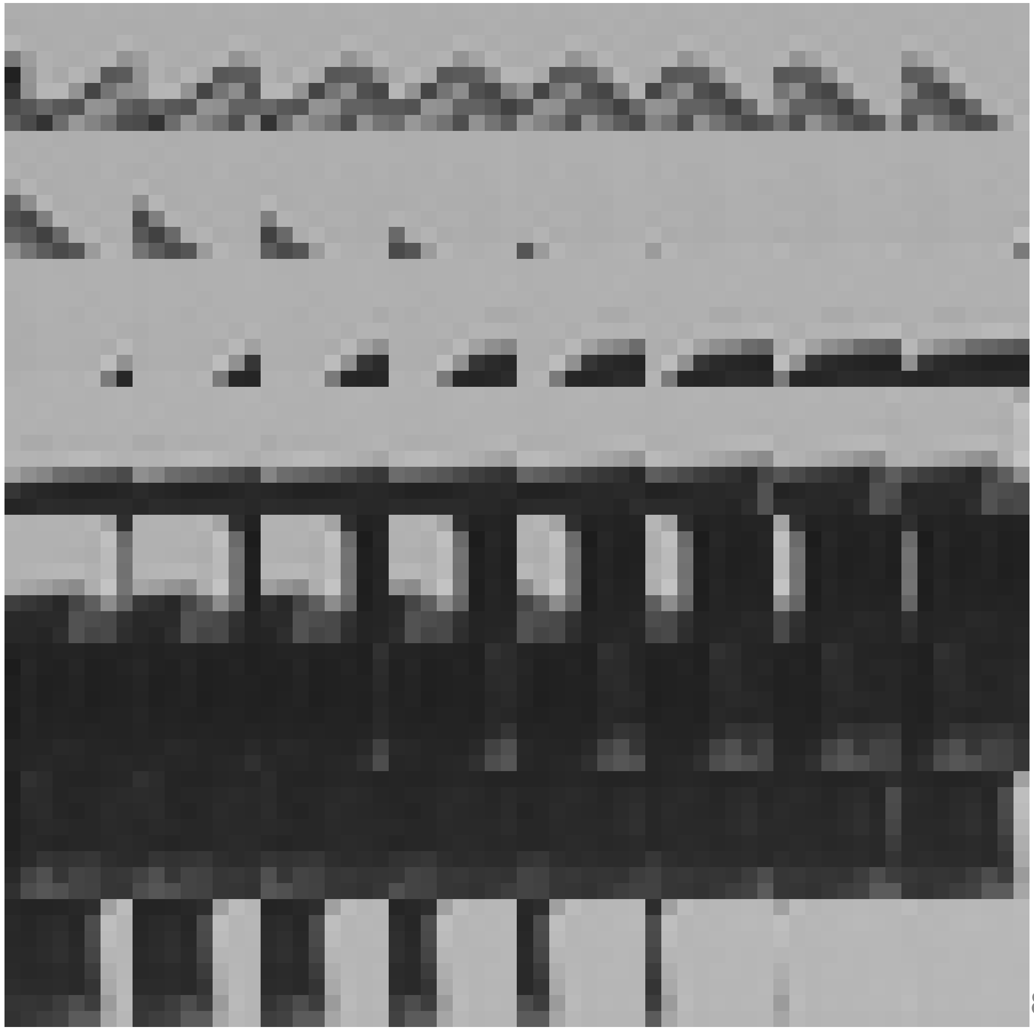
II.2 Grouping Disparities Yielding Similar Block Reconstructions

64 possible reconstructions :



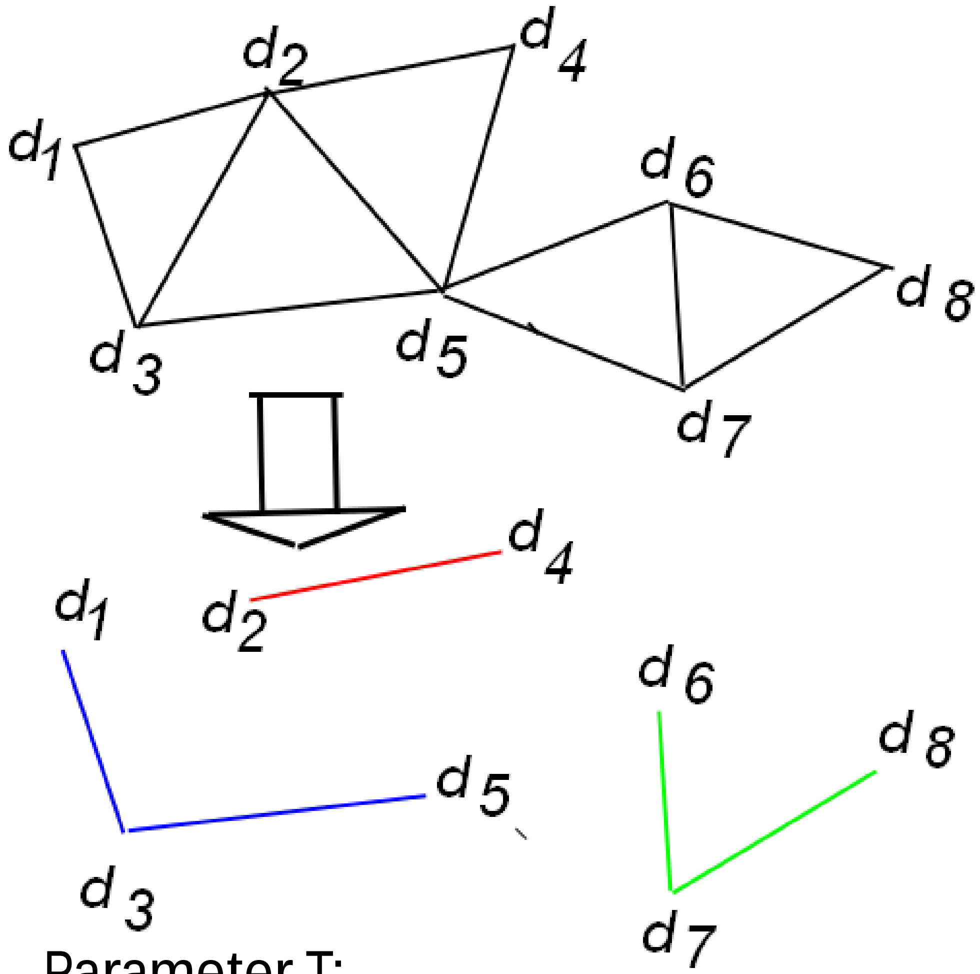
I^r





$R(i,j)$	distance
$\varphi^{-1}(s)$	subset of disparities
$\varphi^{INV}(s)$	center of subset
$\varphi \Rightarrow \psi$	reordering of indexes

II.3 Dictionary As a Graph



Parameter T:

i and j are connected if R(i,j)<=T

Goal: min |S|

Subsets of disparities

$$\varphi^{-1}(\{1\}) = \{d_1, d_3, d_5\}$$

$$\varphi^{-1}(\{2\}) = \{d_2, d_4\}$$

$$\varphi^{-1}(\{3\}) = \{d_6, d_7, d_8\}$$

Elements of the dictionary

$$d_3 = \varphi^{INV}(1)$$

$$d_4 = \varphi^{INV}(2)$$

$$d_7 = \varphi^{INV}(3)$$

Reordering the dictionary

$$\psi^{-1}(\{1\}) = \{d_1, d_3, d_5\}$$

$$\psi^{-1}(\{2\}) = \{d_6, d_7, d_8\}$$

$$\psi^{-1}(\{3\}) = \{d_2, d_4\}$$

II.5 Kmeans-Inspired Solution

Repeat as long as needed

1. Adding new elements to the dictionary

   if $\max_{i \in \varphi^{INV}(S)} R(i,d) > T$

   then $\varphi^{INV}(|S|+1) := d$ and $S := S \cup \{|S|+1\}$

2. Assigning indexes to each disparity

   $$\varphi(d) := \arg\min_{s \in S} R\left(d, \varphi^{INV}(\{s\})\right)$$

3. Choosing the center of each subset of disparities

   $$\varphi^{INV}(s) := \arg\min_{d \in \varphi^{-1}(\{s\})} \sum_{j \in \varphi^{-1}(\{s\})} R(d, j)$$

4. Suppressing dictionary elements being too similar

   If $R\left(\varphi^{INV}(s_1), \varphi^{INV}(s_2)\right) \leq T$ then $S := S \setminus \{s_2\}$

S: set of dictionary elements

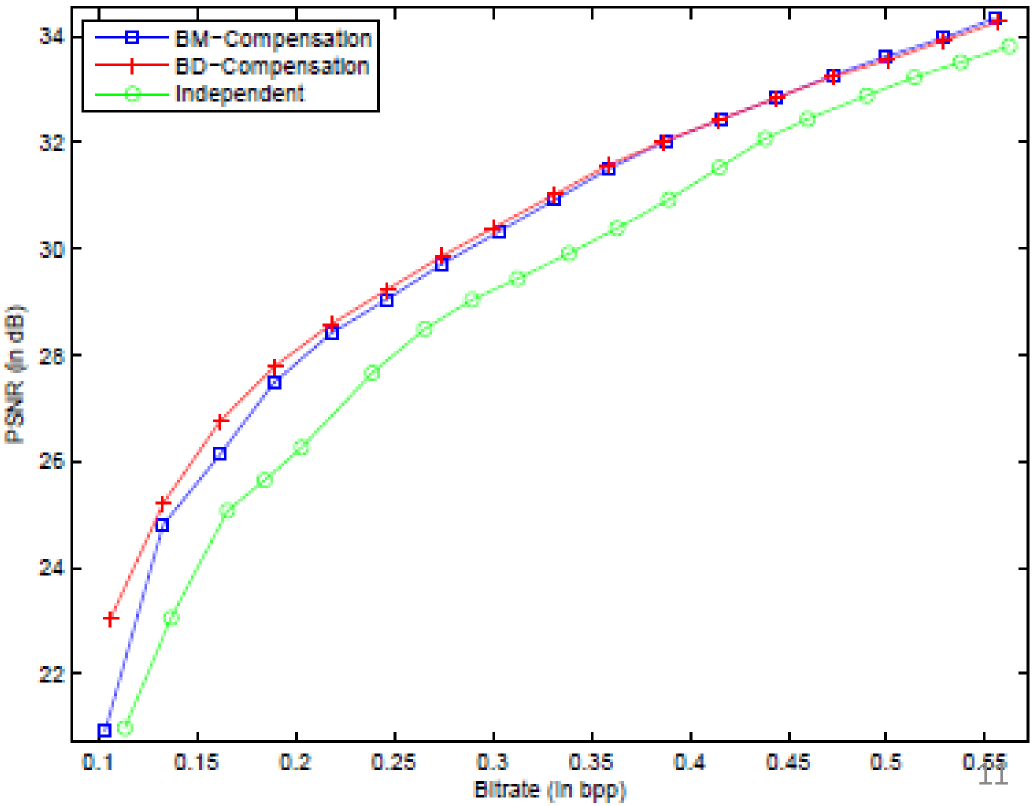
$\varphi^{INV}(s)$: dictionary elements

III.1 Results

Bitrate of disparity maps and distortion of disparity-compensated left images

	Block Dictionary		Block Matching	
Stereo Images	Bitrate	PSNR	Bitrate	PSNR
DEIMOS_8	0.045	25.49	0.068	25.56
DEIMOS_13	0.060	24.91	0.072	24.96
DEIMOS_67	0.037	30.72	0.064	30.99
JISCT_Synth	0.073	23.76	0.083	23.86
CMU_Fruit	0.060	18.36	0.086	18.56
SYNTIM_Angle	0.030	29.18	0.054	29.78

Average PSNR versus average bitrate of the stereo pair DEIMOS-8 for Block Dictionary, Block Matching and independant coding



III.2 Conclusion

- Disparity Compensated Based Stereoscopic Image Coding

  Choice of disparity is a trade-off (distortion/bitrate)
- Main Contribution: prevent the possibility of selecting disparities being too similar to other disparities
- Performance of the algorithm are hindered: difficult to find the best value of parameter T and of block size
- Numerical complexity of computing distances R_{ij} s
- Numerical Complexity to Explore Parameter's Domain