CS754 Assignment-3

Saksham Rathi, Ekansh Ravi Shankar, Kshitij Vaidya

Declaration: The work submitted is our own, and we have adhered to the principles of academic honesty while completing and submitting this work. We have not referred to any unauthorized sources, and we have not used generative AI tools for the work submitted here.

Question 2

Solution

0.1 Linear System Representation

The coded snapshot equation $E = \sum_{t=1}^{T} \mathbf{C}_t \odot \mathbf{F}_t$ can be rewritten as the linear system:

$$\mathbf{A}\mathbf{x} = \mathbf{b},$$

where:

1. $\mathbf{x}$ is the **vectorized unknown video sequence**, formed by stacking the vectorized frames $\mathbf{F}_t$:

$$\mathbf{x} = \begin{bmatrix} \text{vec}(\mathbf{F}_1) \\ \text{vec}(\mathbf{F}_2) \\ \vdots \\ \text{vec}(\mathbf{F}_T) \end{bmatrix} \in \mathbb{R}^{HWT \times 1}.$$

2. $\mathbf{b}$ is the **vectorized coded snapshot**:

$$\mathbf{b} = \text{vec}(E) \in \mathbb{R}^{HW \times 1}.$$

3. $\mathbf{A}$ is the **measurement matrix** encoding the modulation by $\mathbf{C}_t$. It is a block-diagonal matrix with horizontally concatenated diagonal matrices:

$$\mathbf{A} = \begin{bmatrix} \text{diag}(\text{vec}(\mathbf{C}_1)) & \text{diag}(\text{vec}(\mathbf{C}_2)) & \cdots & \text{diag}(\text{vec}(\mathbf{C}_T)) \end{bmatrix} \in \mathbb{R}^{HW \times HWT}.$$

   Each block $\text{diag}(\text{vec}(\mathbf{C}_t))$ is a diagonal matrix whose entries are the vectorized binary code $\mathbf{C}_t$ for frame t.

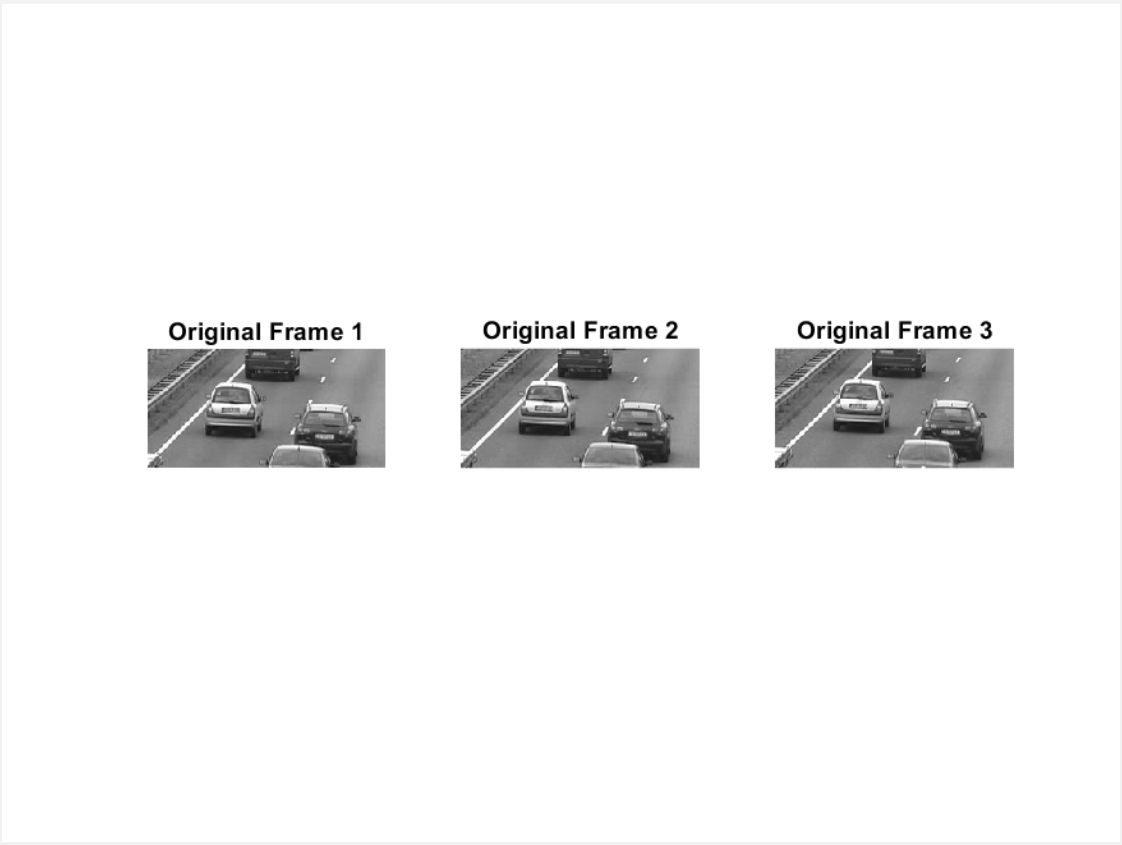

Figure 1: Original Frames for T = 3

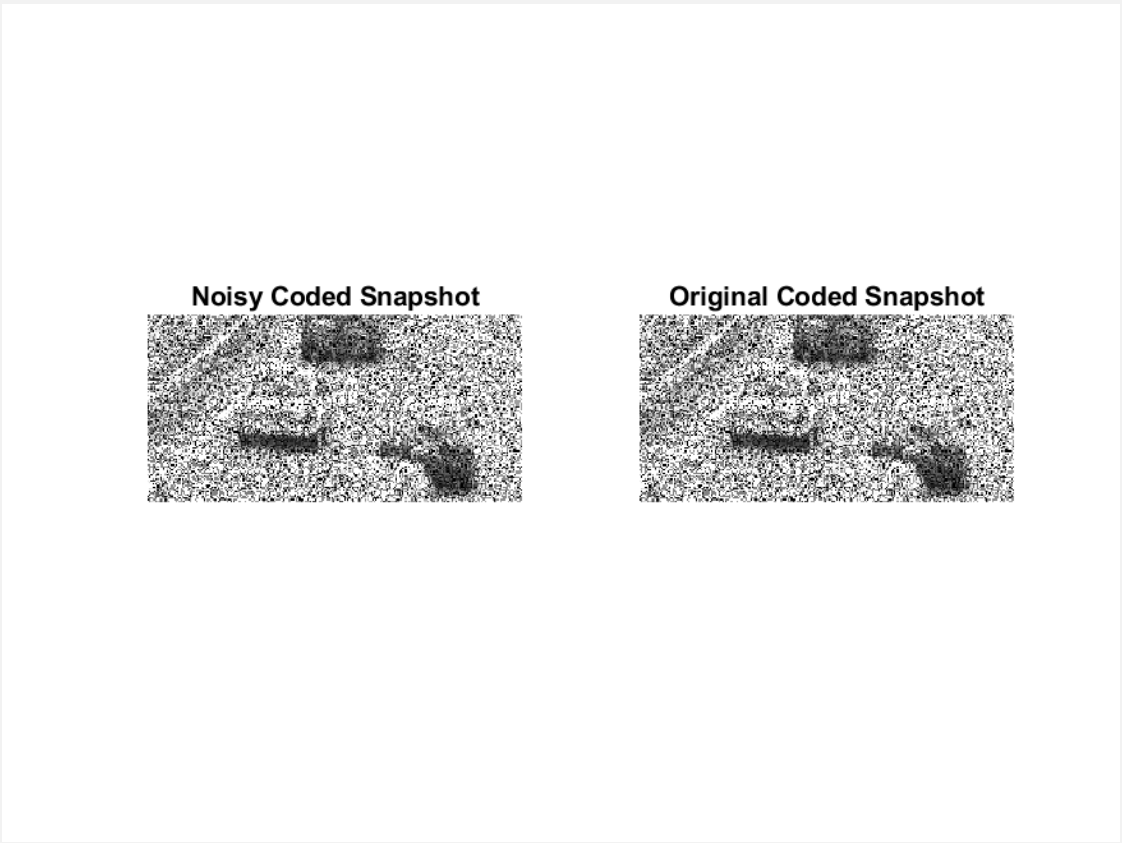

Figure 2: Encoded Snapshot for T = 3

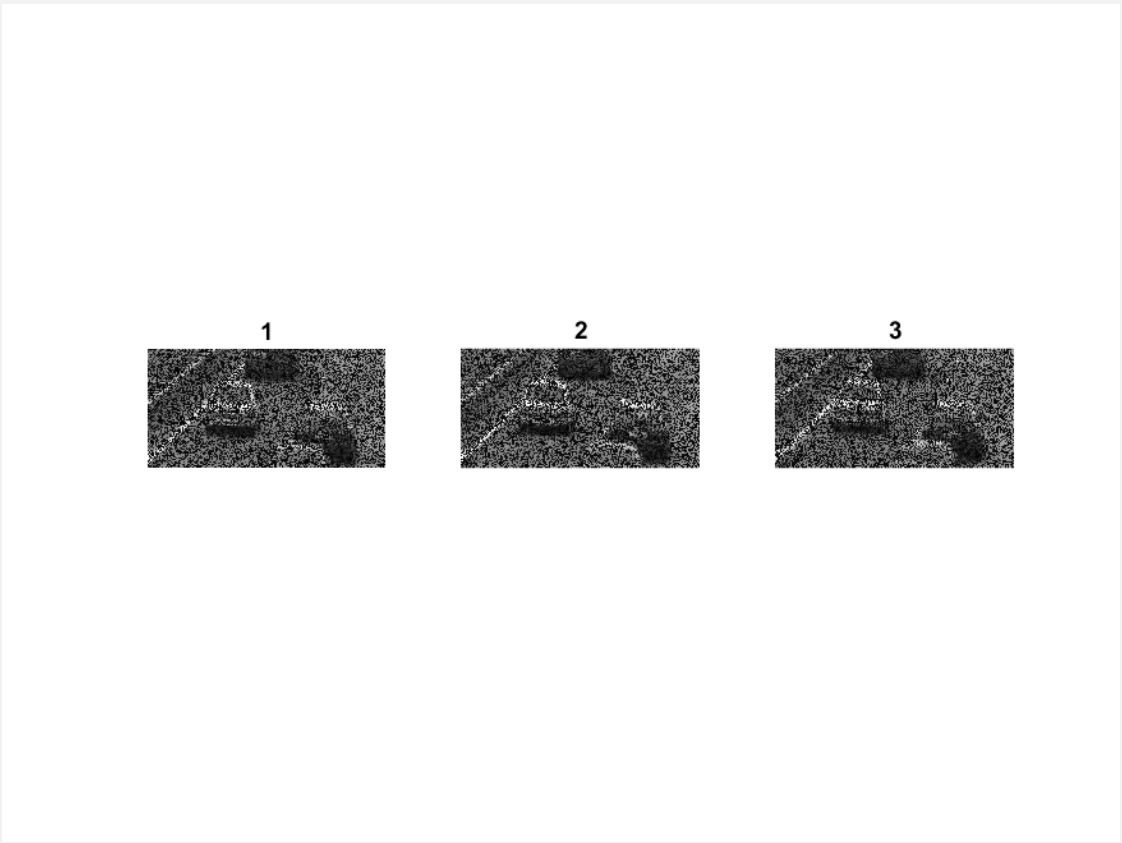

Figure 3: Reconstructed Frames for T = 3

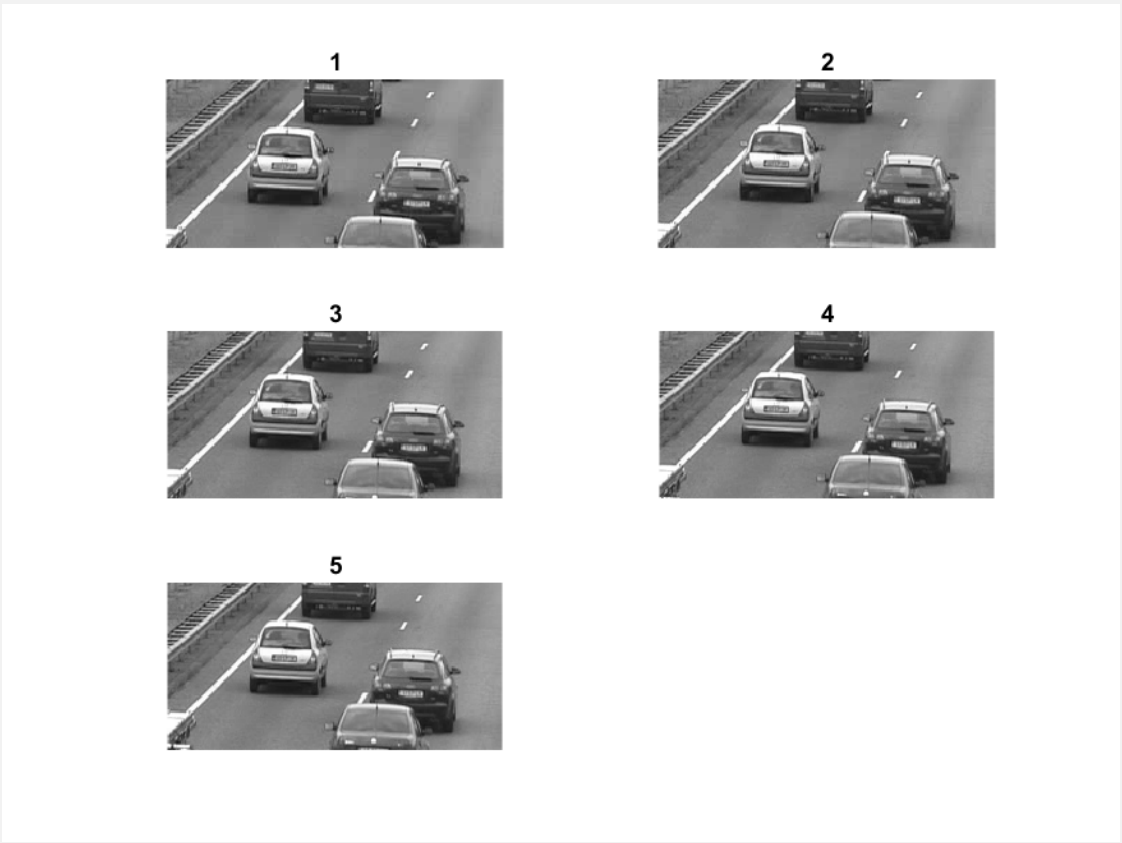

Figure 4: Original Frames for T = 5

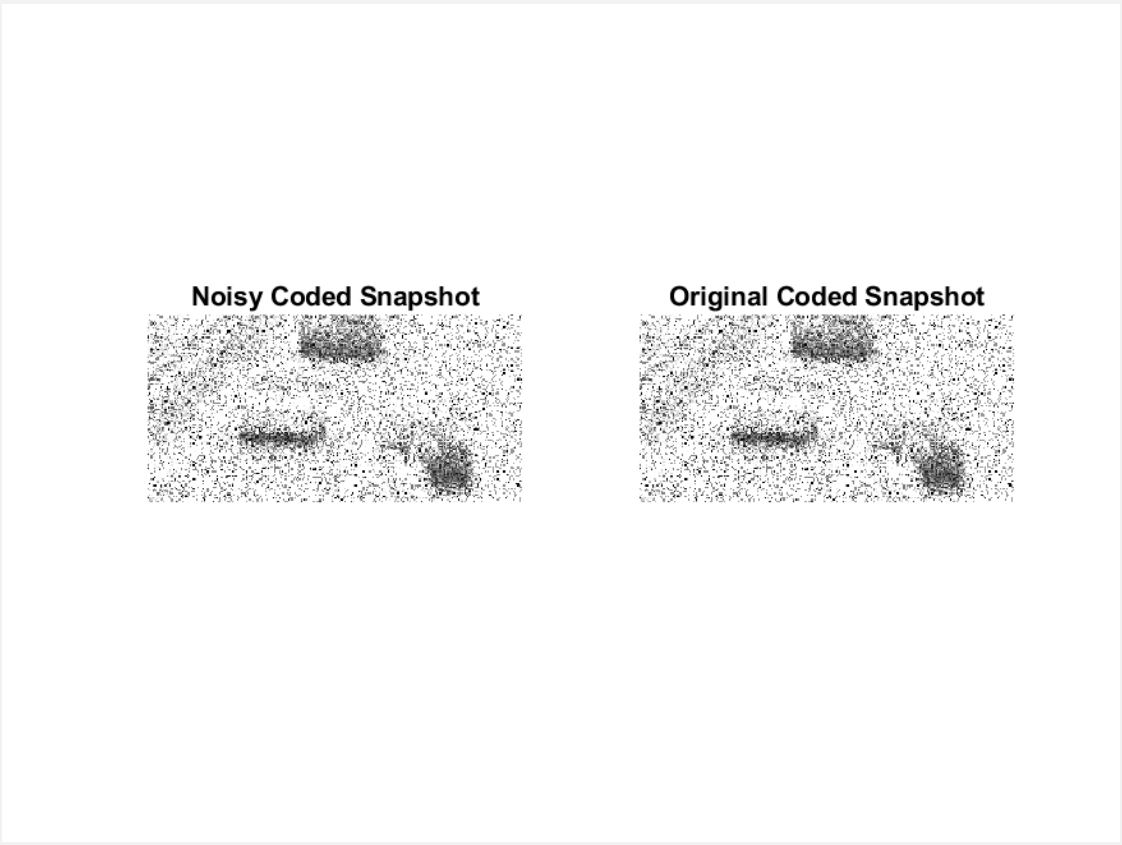

Figure 5: Encoded Snapshot for T = 5

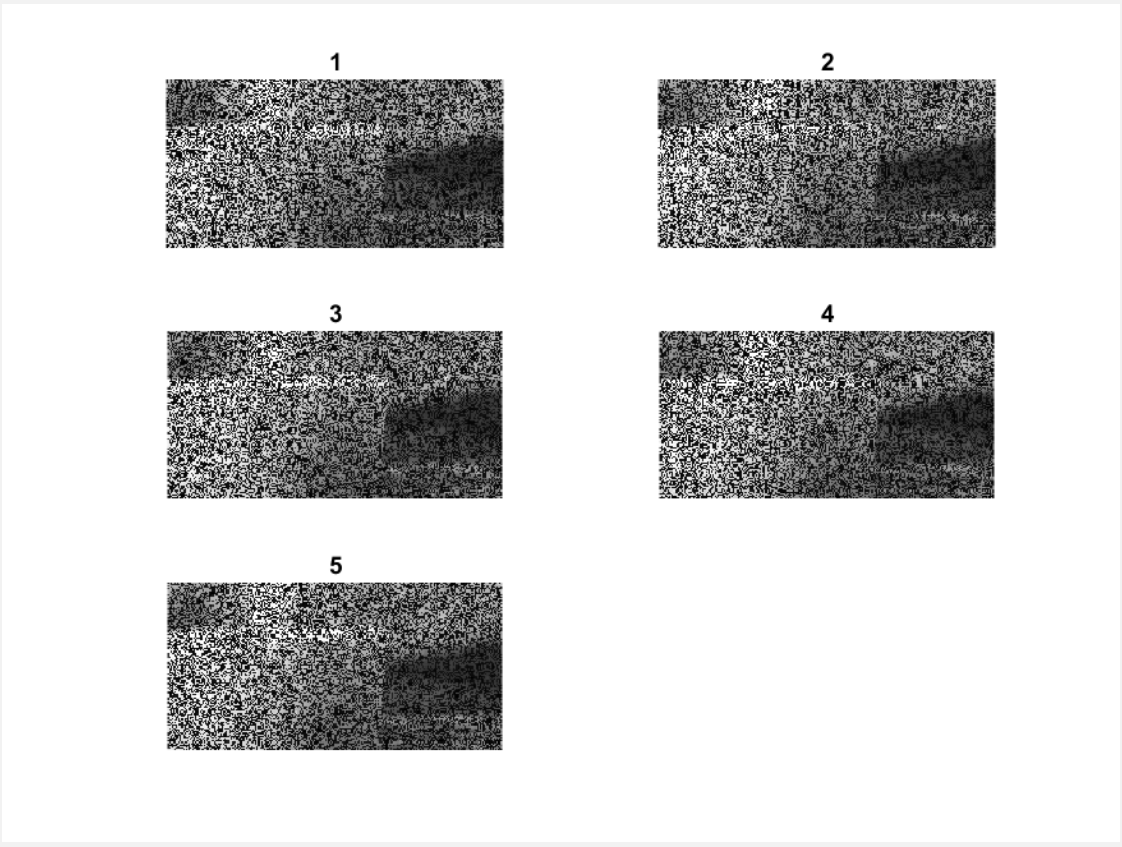

Figure 6: Reconstructed Frames for T = 5

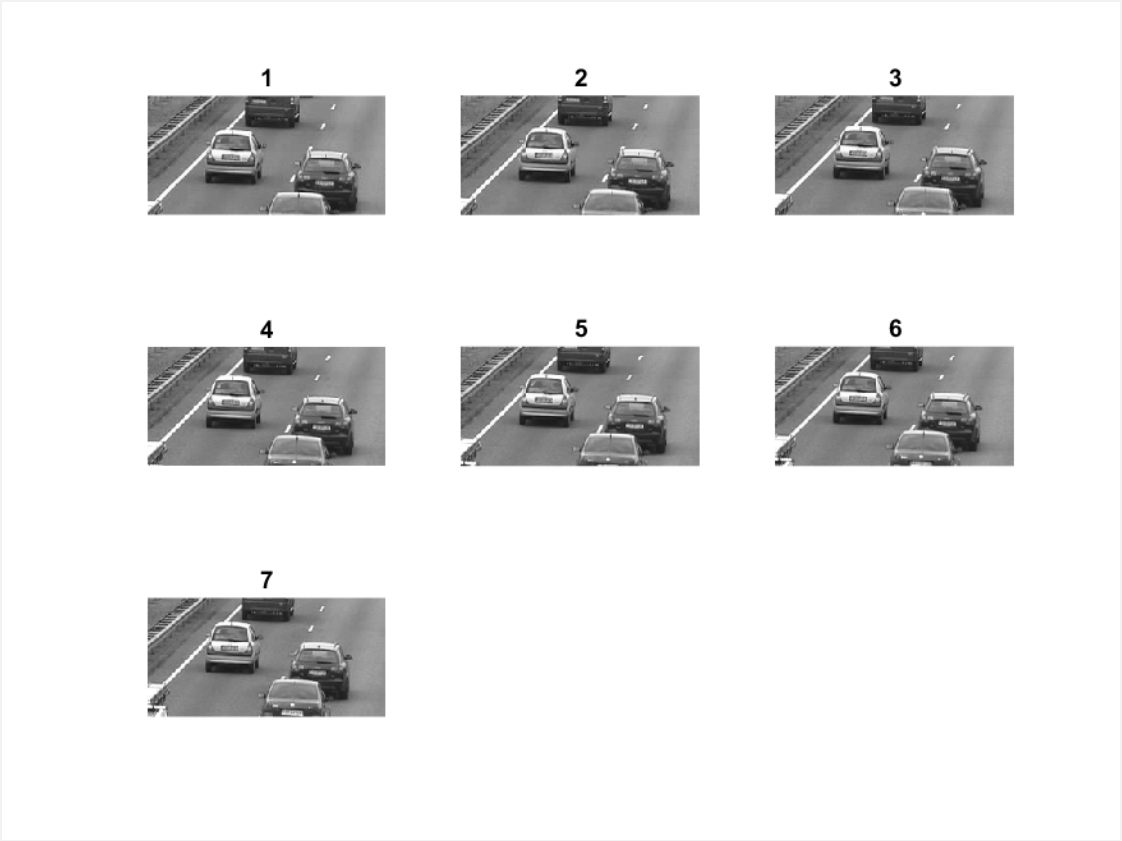

Figure 7: Original Frames for T = 7

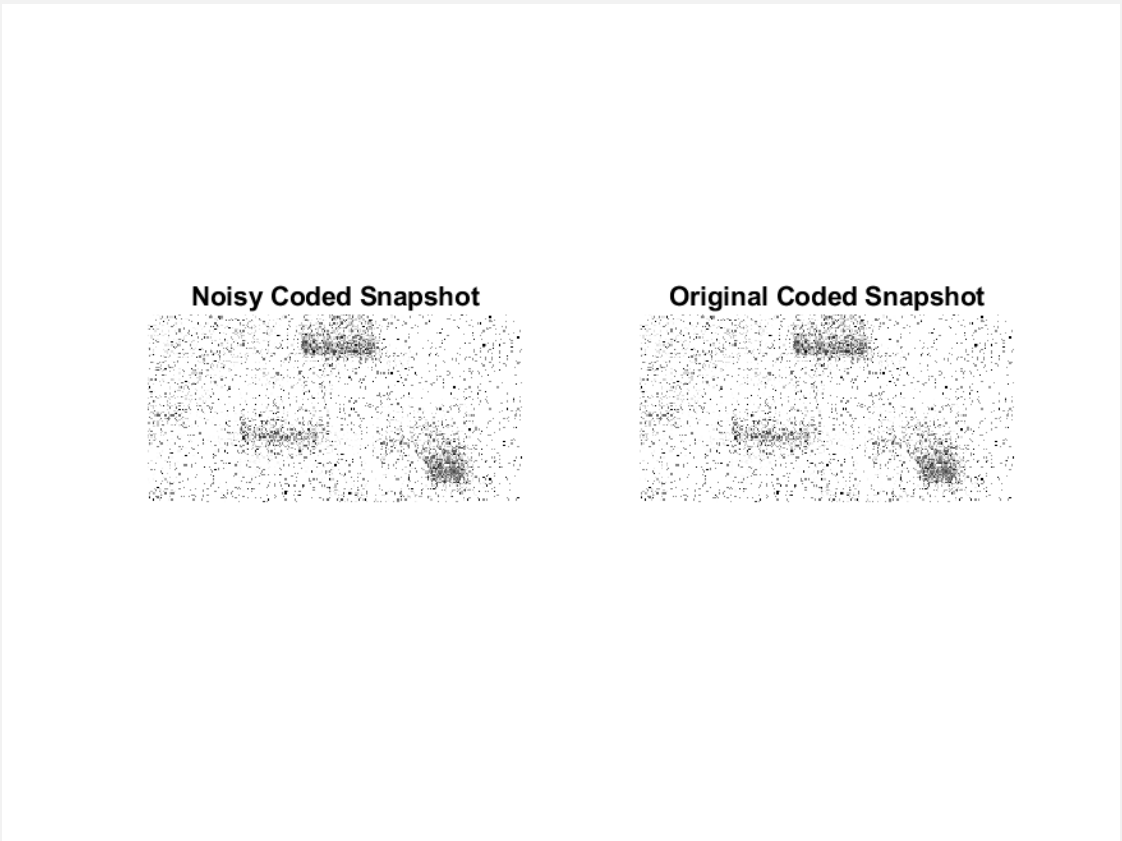

Figure 8: Encoded Snapshot for T = 7

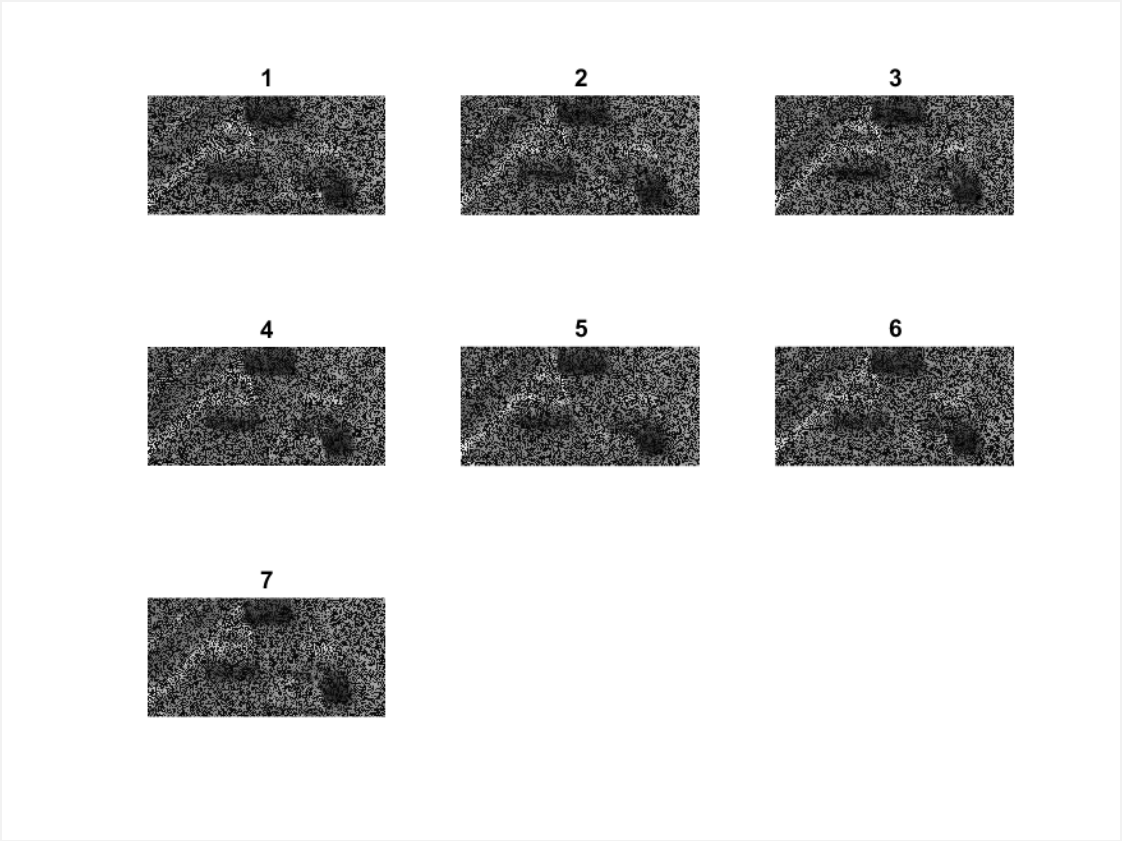

Figure 9: Reconstructed Frames for T = 7

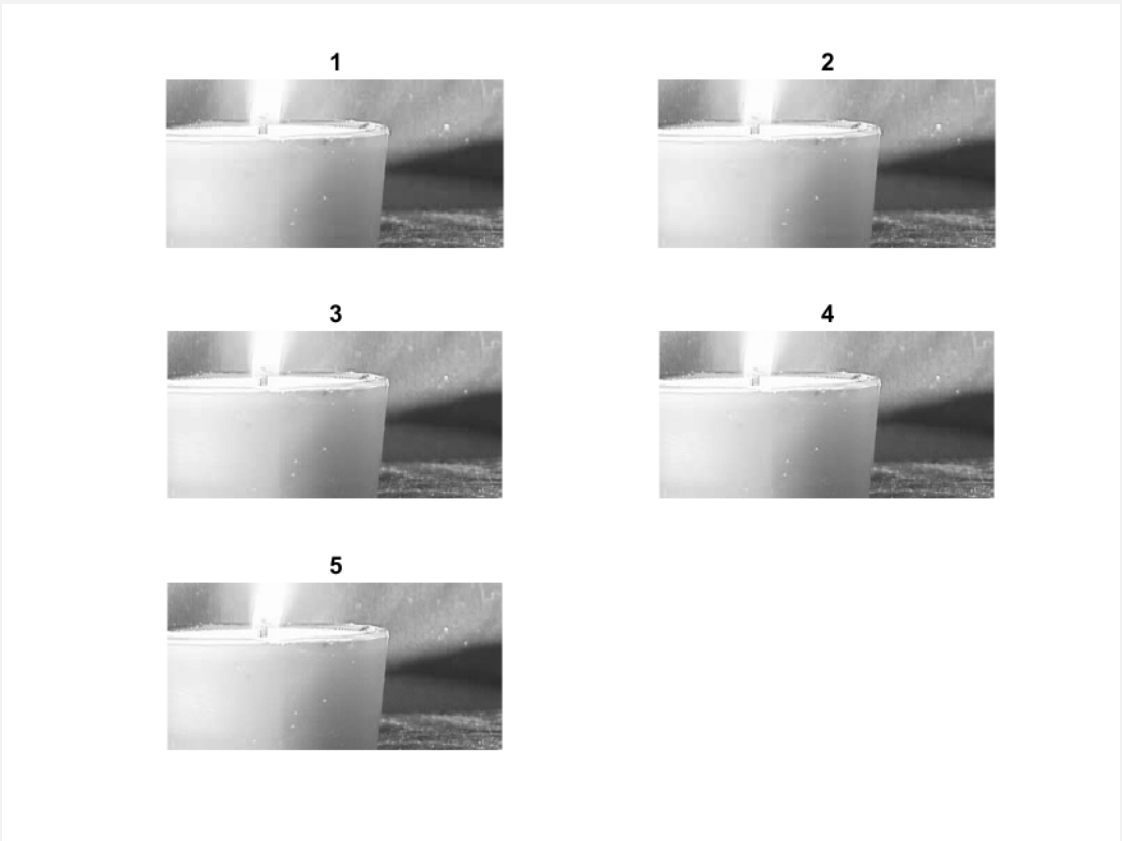

Figure 10: Original Frames for T = 5 : Flame Video

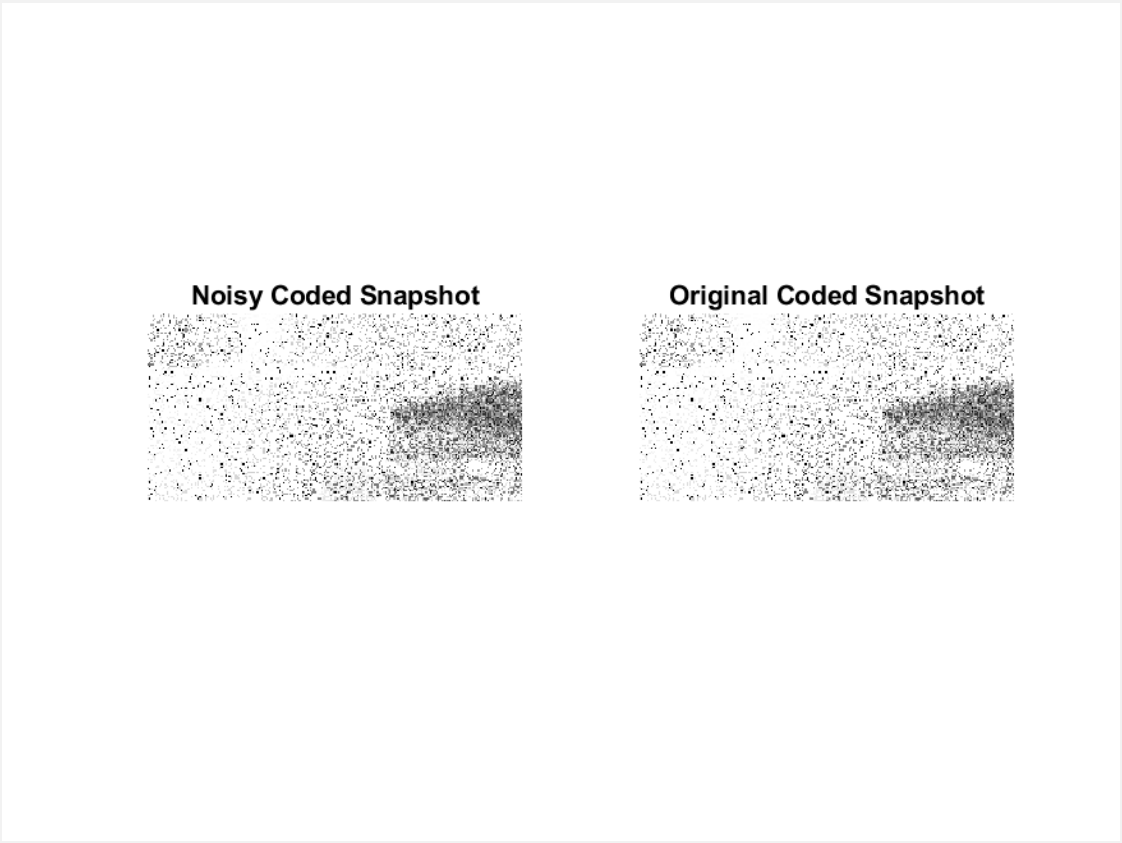

Figure 11: Encoded Snapshot for T = 5 : Flame Video