

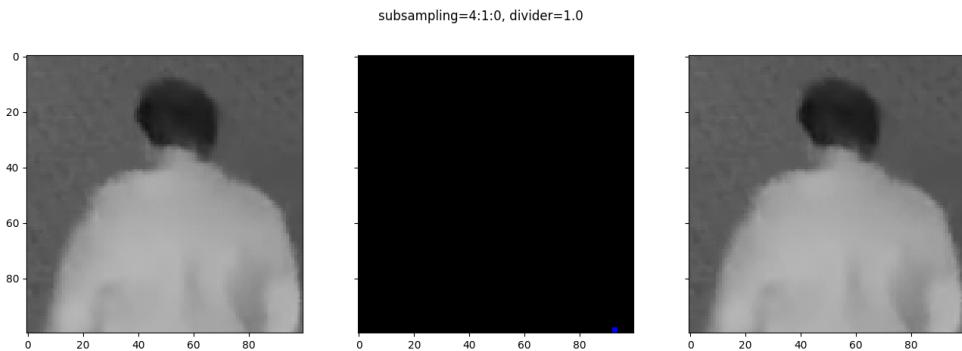
Kompresja video

Część 1:

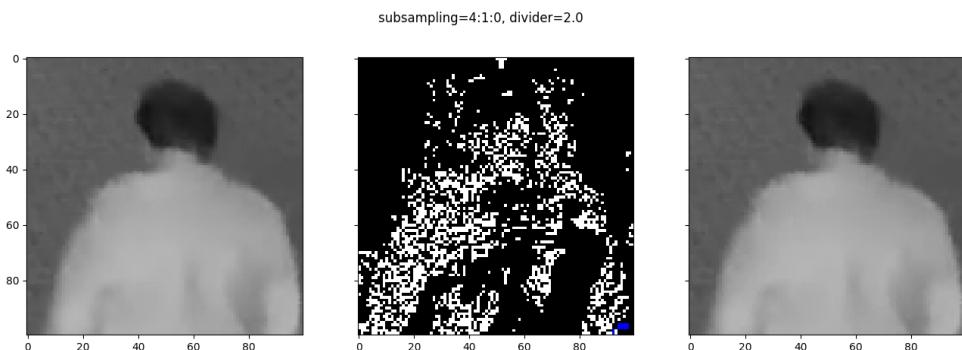
clip_3

Subsampling 4:1:0

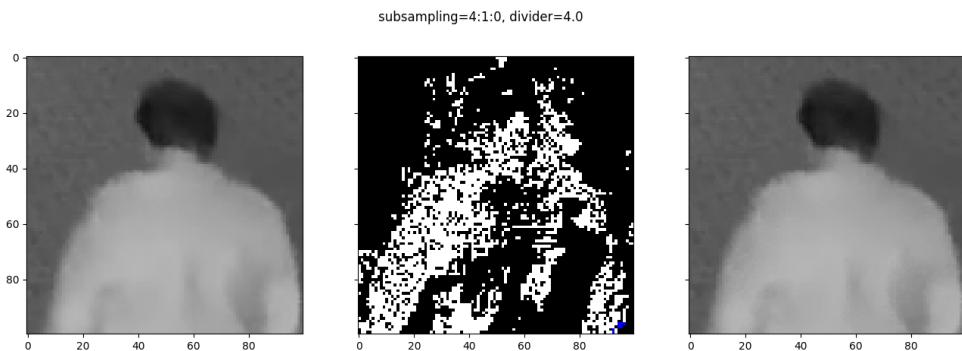
x/1



x/2

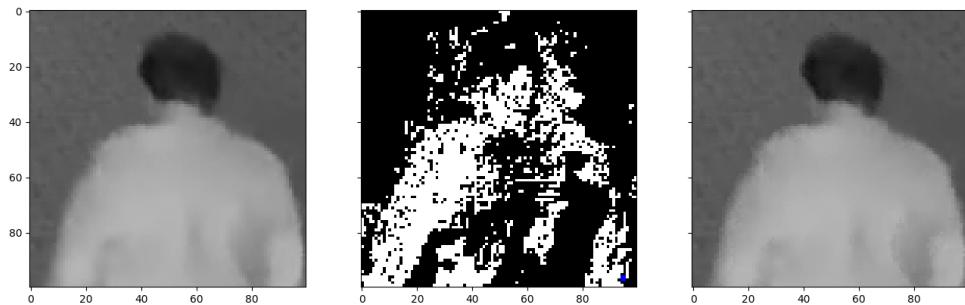


x/4



$x/8$

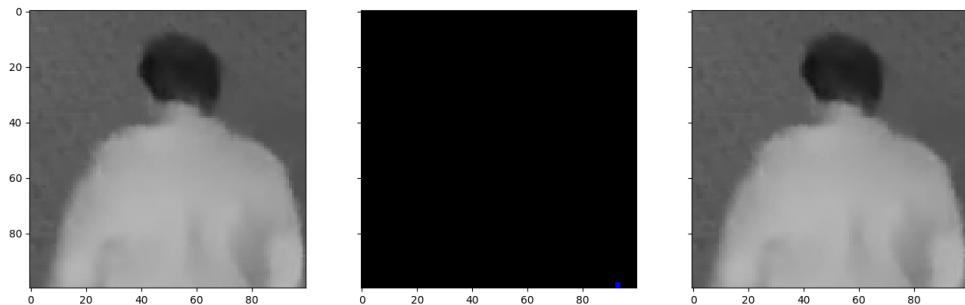
subsampling=4:1:0, divider=8.0



Subsampling 4:1:1

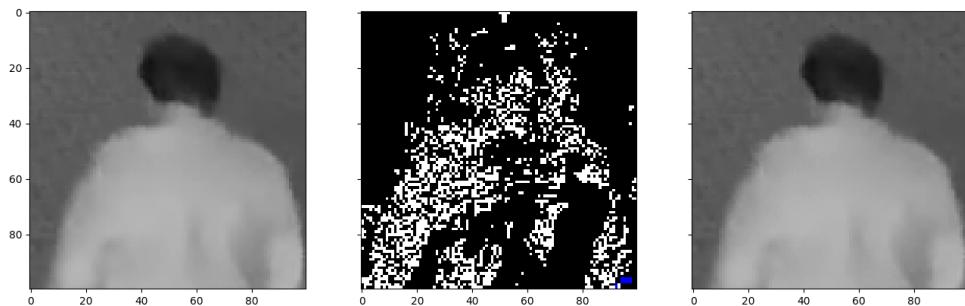
$x/1$

subsampling=4:1:1, divider=1.0



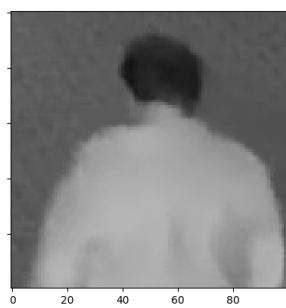
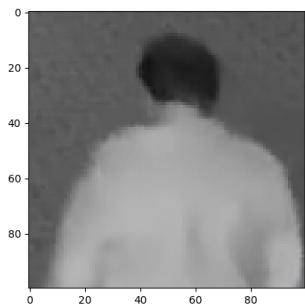
$x/2$

subsampling=4:1:1, divider=2.0



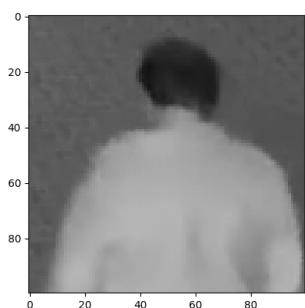
x/4

subsampling=4:1:1, divider=4.0



x/8

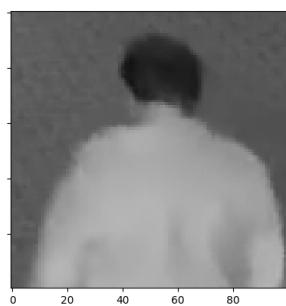
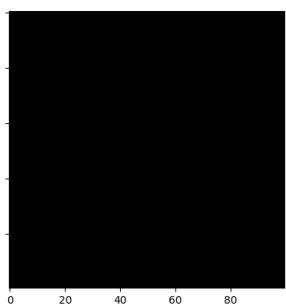
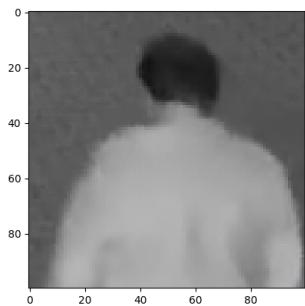
subsampling=4:1:1, divider=8.0



Subsampling 4:2:0

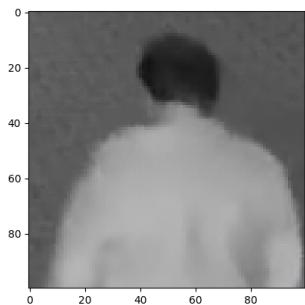
x/1

subsampling=4:2:0, divider=1.0



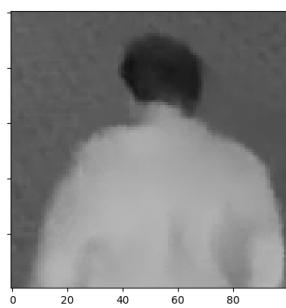
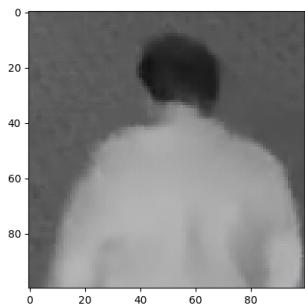
x/2

subsampling=4:2:0, divider=2.0



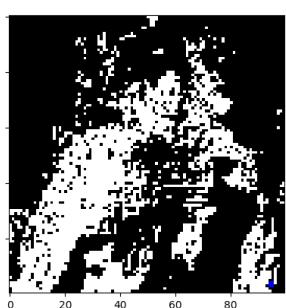
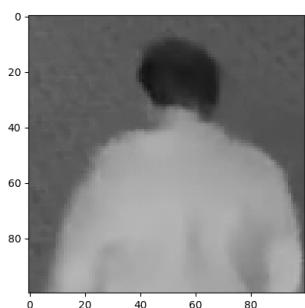
x/4

subsampling=4:2:0, divider=4.0



x/8

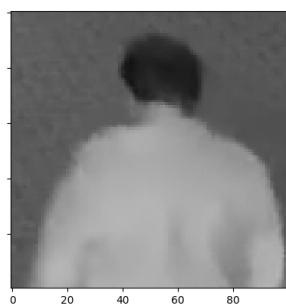
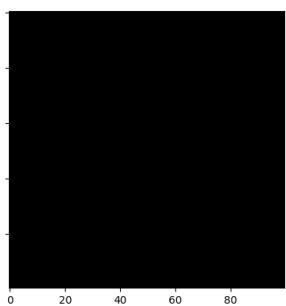
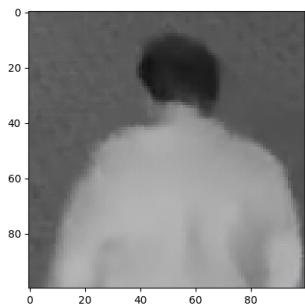
subsampling=4:2:0, divider=8.0



Subsampling 4:2:2

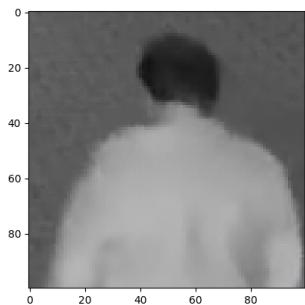
x/1

subsampling=4:2:2, divider=1.0



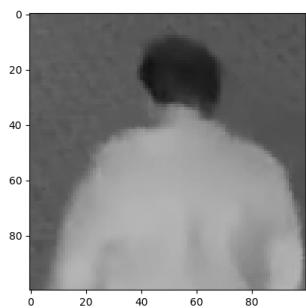
x/2

subsampling=4:2:2, divider=2.0



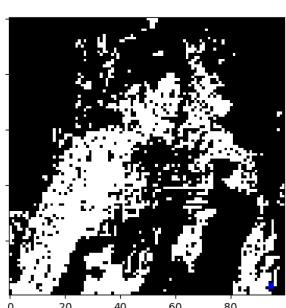
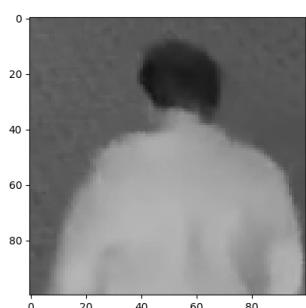
x/4

subsampling=4:2:2, divider=4.0



x/8

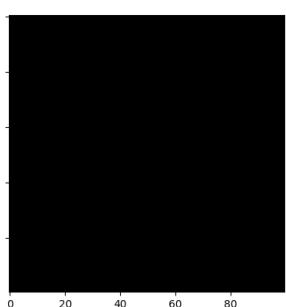
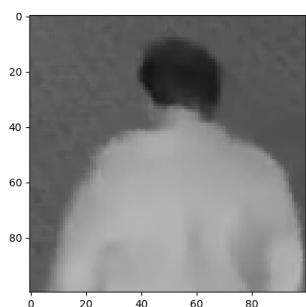
subsampling=4:2:2, divider=8.0



Subsampling 4:4:0

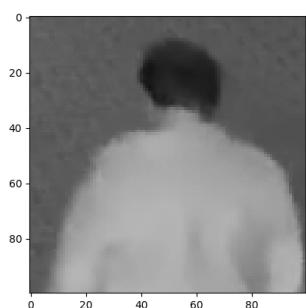
x/1

subsampling=4:4:0, divider=1.0



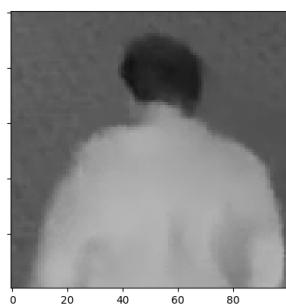
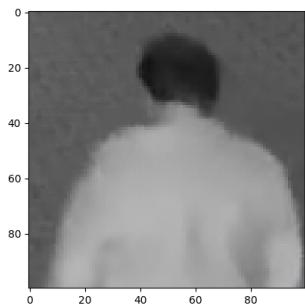
x/2

subsampling=4:4:0, divider=2.0



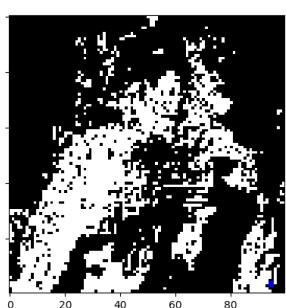
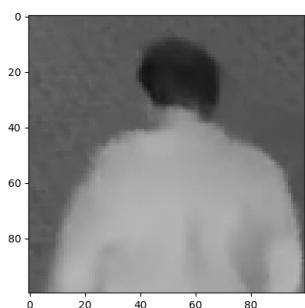
x/4

subsampling=4:4:0, divider=4.0



x/8

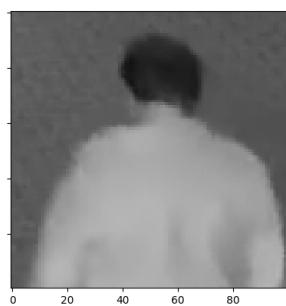
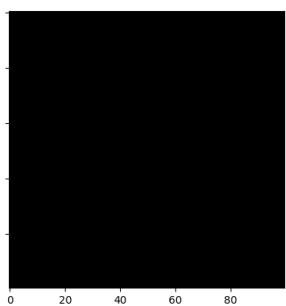
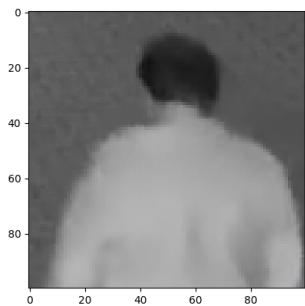
subsampling=4:4:0, divider=8.0



Subsampling 4:4:4

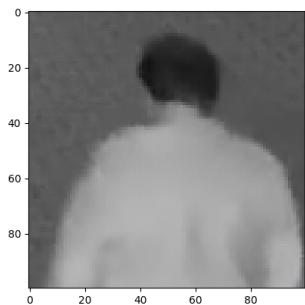
x/1

subsampling=4:4:4, divider=1.0



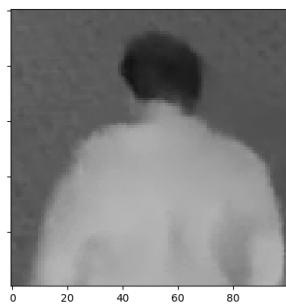
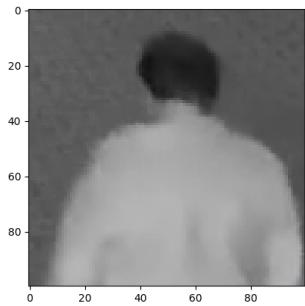
x/2

subsampling=4:4:4, divider=2.0



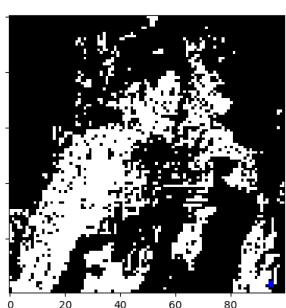
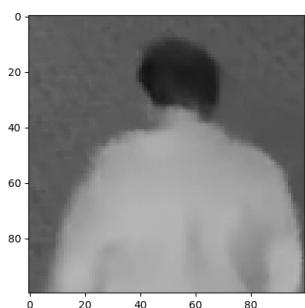
x/4

subsampling=4:4:4, divider=4.0



x/8

subsampling=4:4:4, divider=8.0

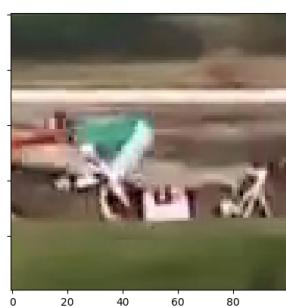
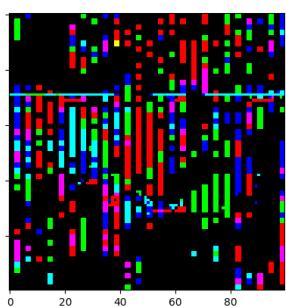
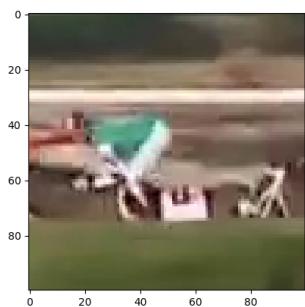


clip_4

Subsampling 4:1:0

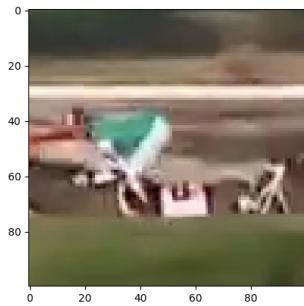
x/1

subsampling=4:1:0, divider=1.0



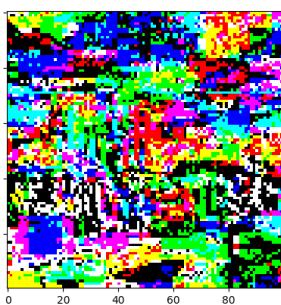
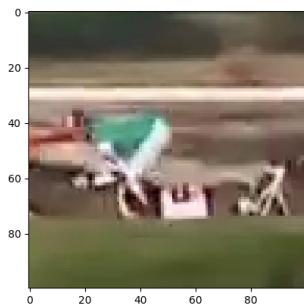
$x/2$

subsampling=4:1:0, divider=2.0



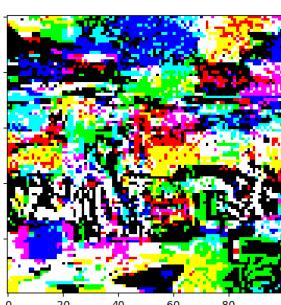
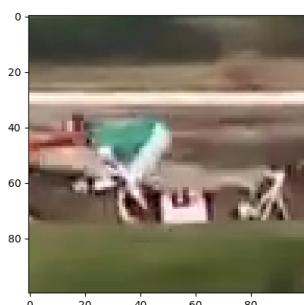
$x/4$

subsampling=4:1:0, divider=4.0



$x/8$

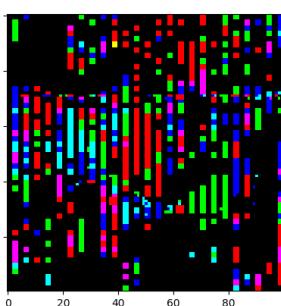
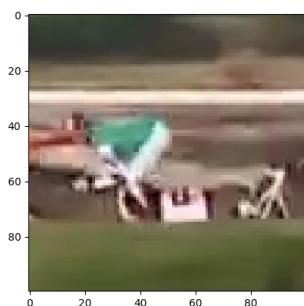
subsampling=4:1:0, divider=8.0



Subsampling 4:1:1

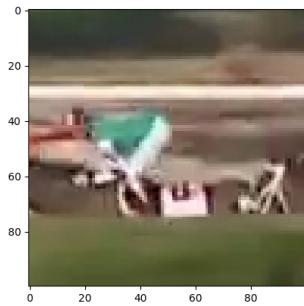
$x/1$

subsampling=4:1:1, divider=1.0



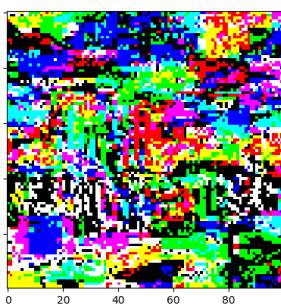
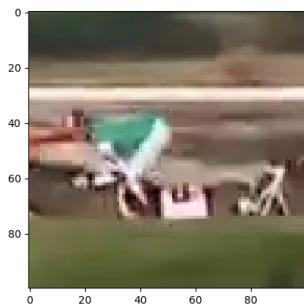
$x/2$

subsampling=4:1:1, divider=2.0



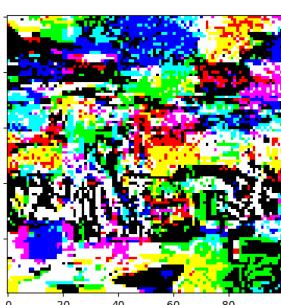
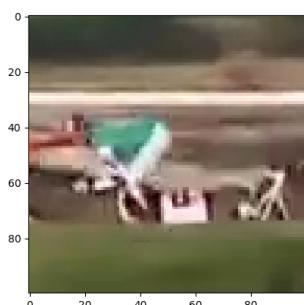
$x/4$

subsampling=4:1:1, divider=4.0



$x/8$

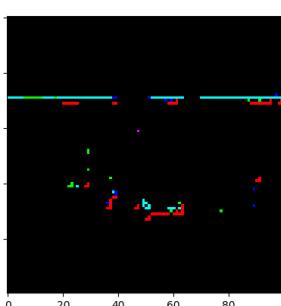
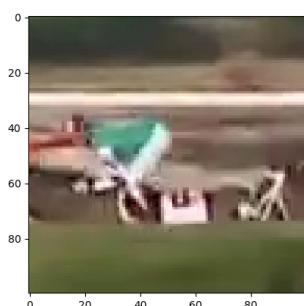
subsampling=4:1:1, divider=8.0



Subsampling 4:2:0

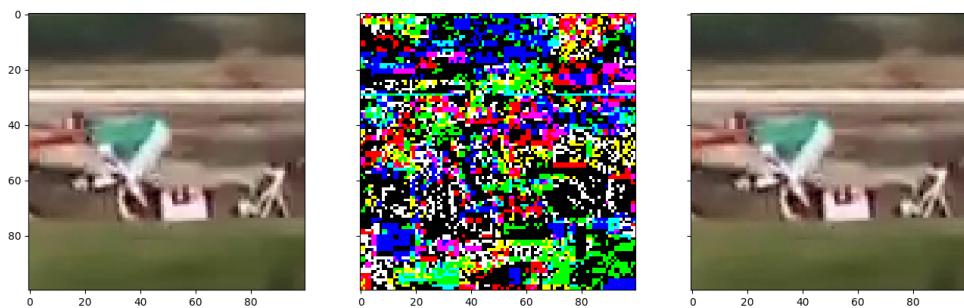
$x/1$

subsampling=4:2:0, divider=1.0



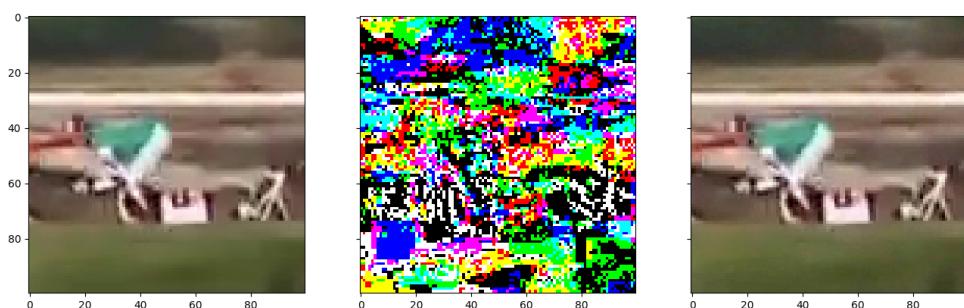
$x/2$

subsampling=4:2:0, divider=2.0



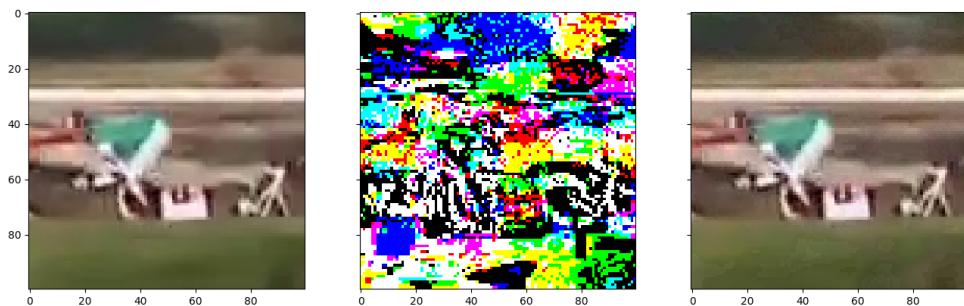
$x/4$

subsampling=4:2:0, divider=4.0



$x/8$

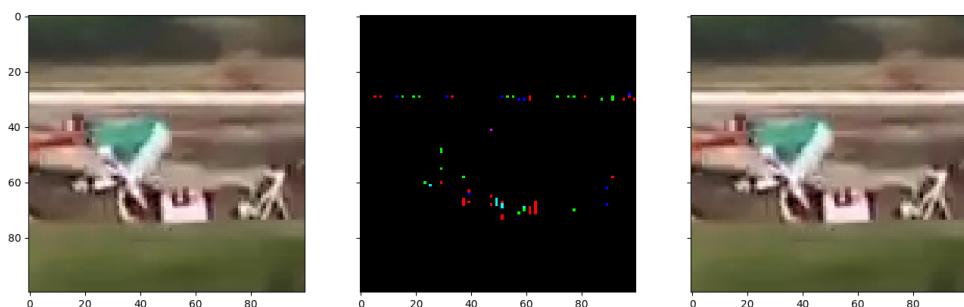
subsampling=4:2:0, divider=8.0



Subsampling 4:2:2

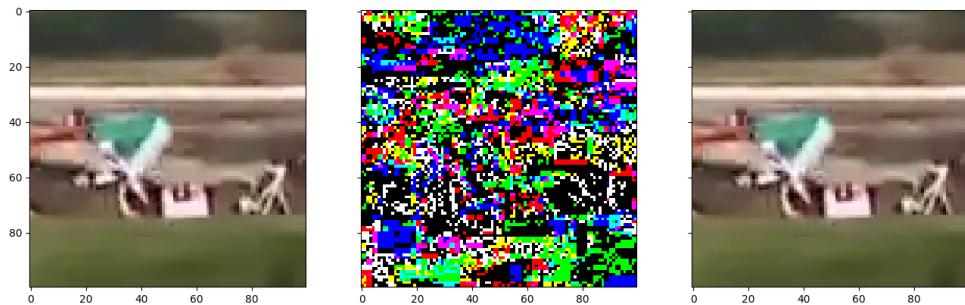
$x/1$

subsampling=4:2:2, divider=1.0



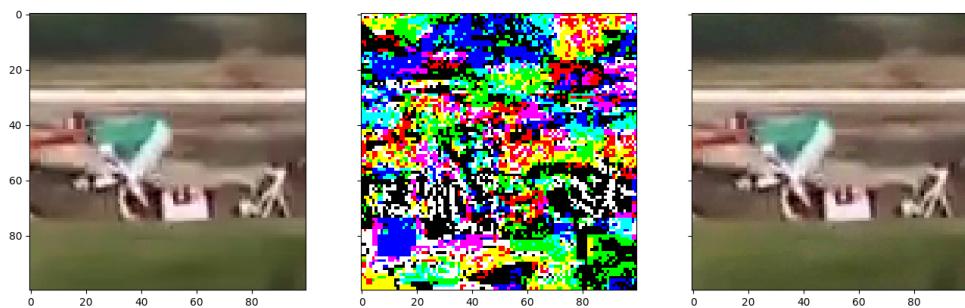
$x/2$

subsampling=4:2:2, divider=2.0



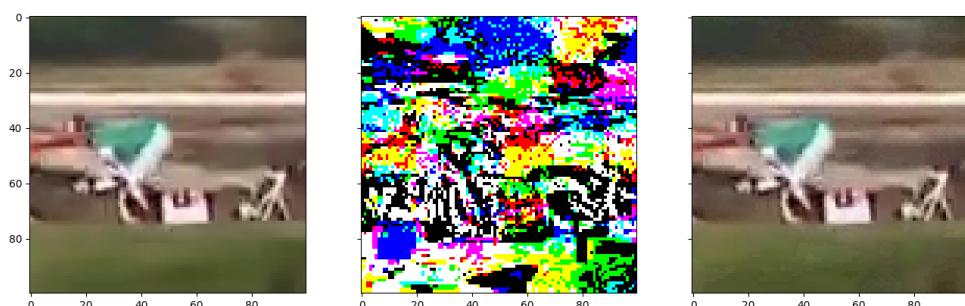
$x/4$

subsampling=4:2:2, divider=4.0



$x/8$

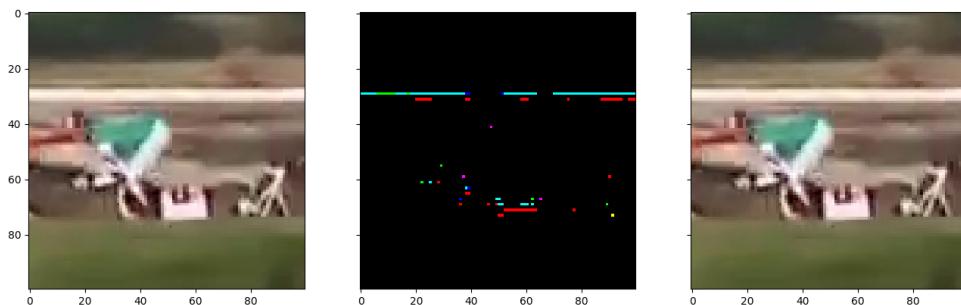
subsampling=4:2:2, divider=8.0



Subsampling 4:4:0

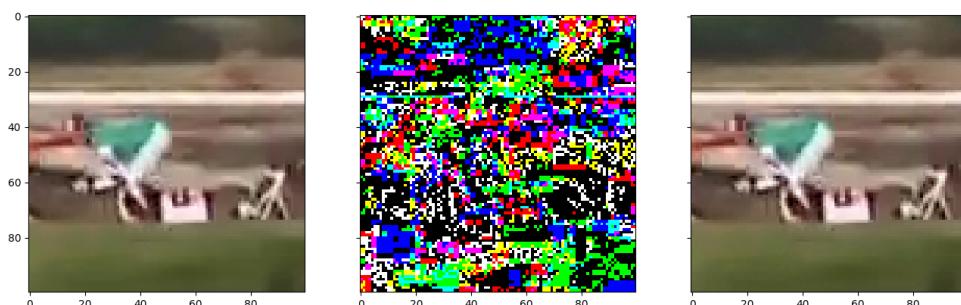
x/1

subsampling=4:4:0, divider=1.0



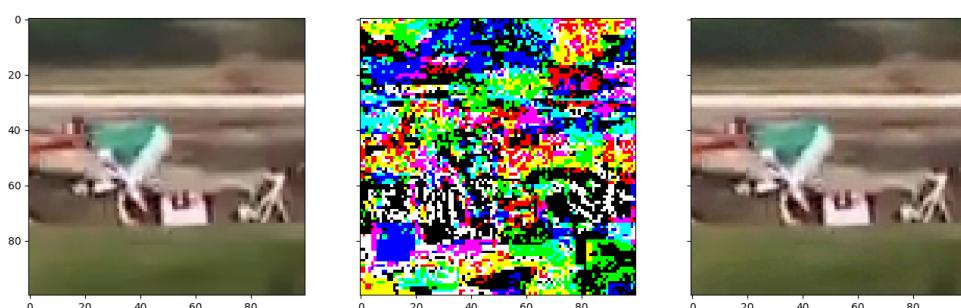
x/2

subsampling=4:4:0, divider=2.0



x/4

subsampling=4:4:0, divider=4.0



x/8

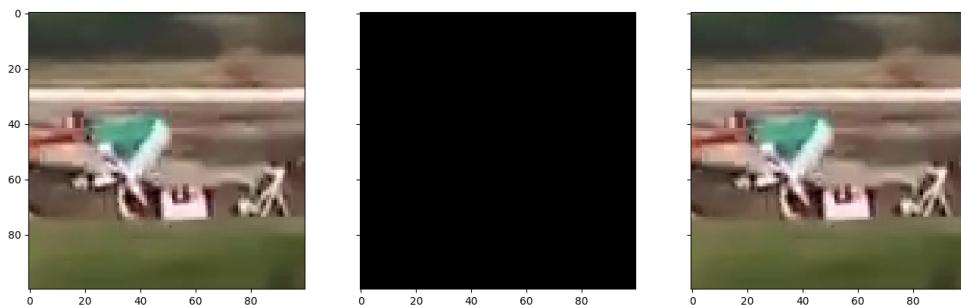
subsampling=4:4:0, divider=8.0



Subsampling 4:4:4

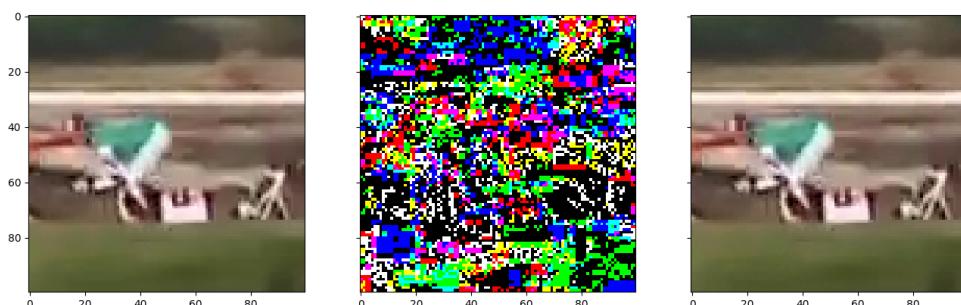
x/1

subsampling=4:4:4, divider=1.0



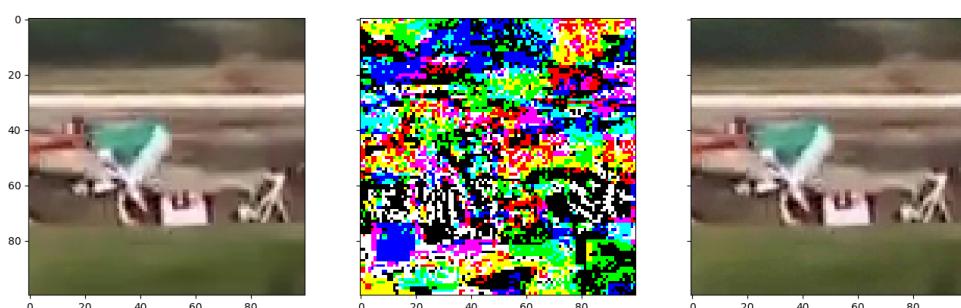
x/2

subsampling=4:4:4, divider=2.0



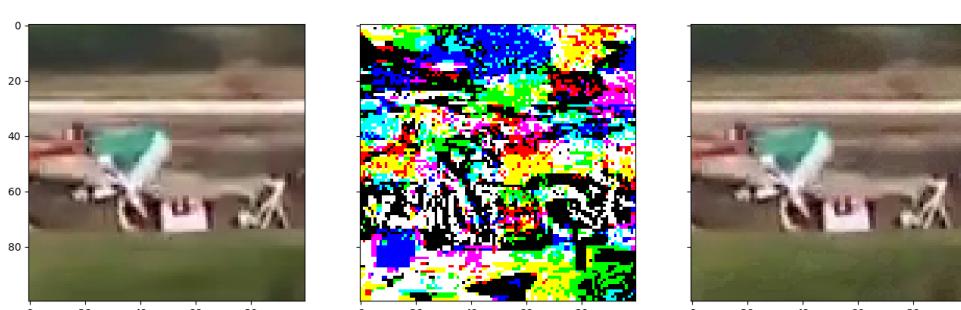
x/4

subsampling=4:4:4, divider=4.0



x/8

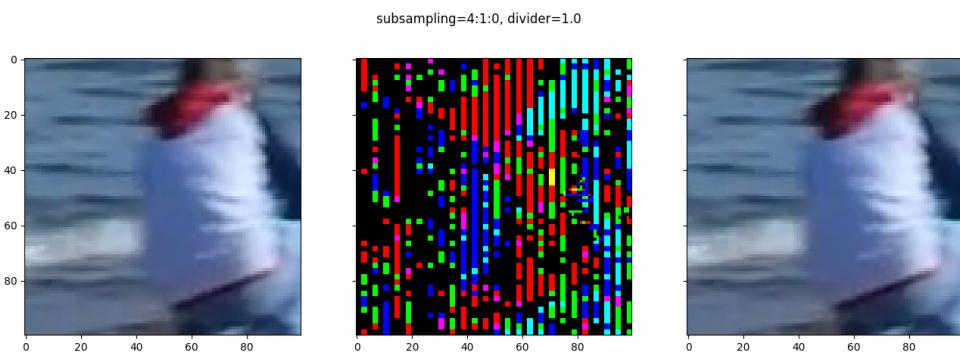
subsampling=4:4:4, divider=8.0



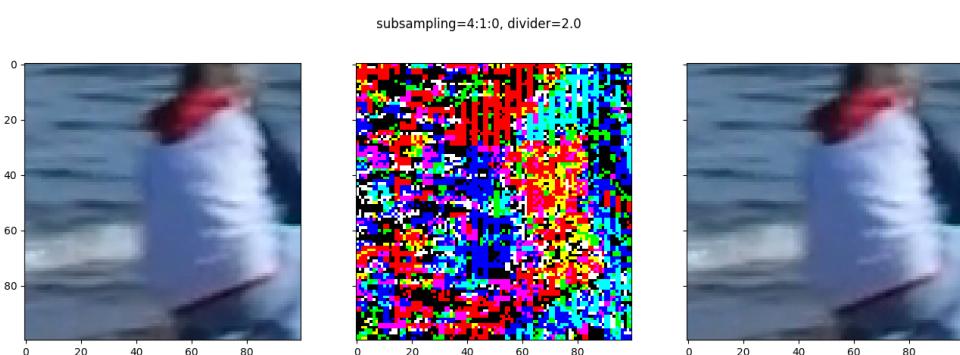
clip_5

Subsampling 4:1:0

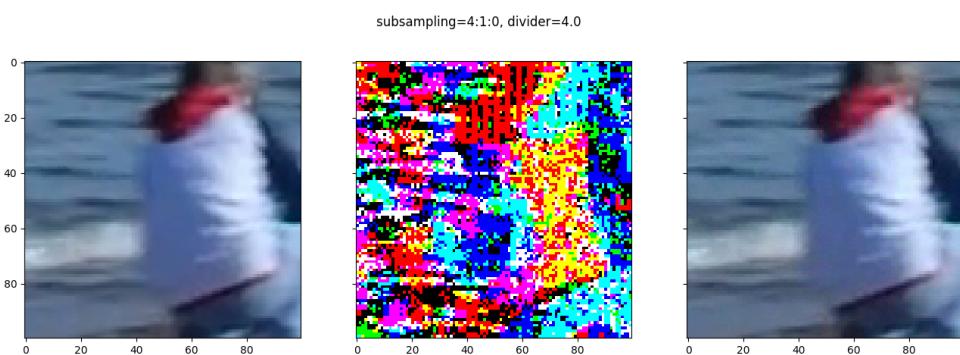
$x/1$



$x/2$

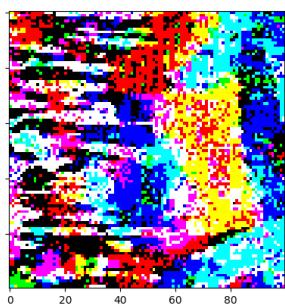
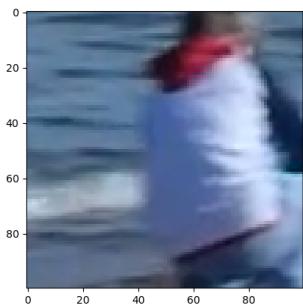


$x/4$



$x/8$

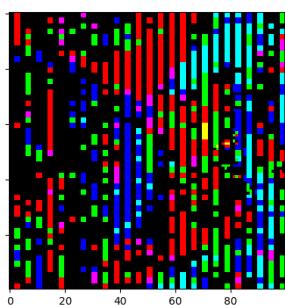
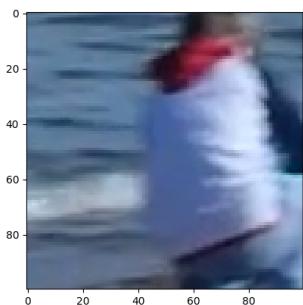
subsampling=4:1:0, divider=8.0



Subsampling 4:1:1

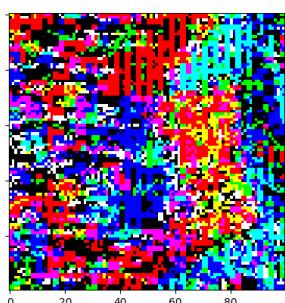
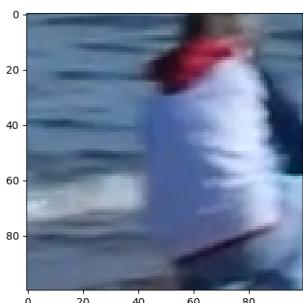
$x/1$

subsampling=4:1:1, divider=1.0



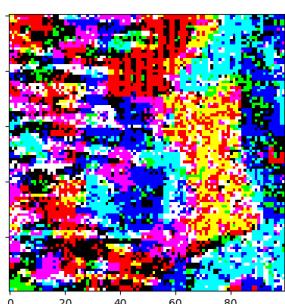
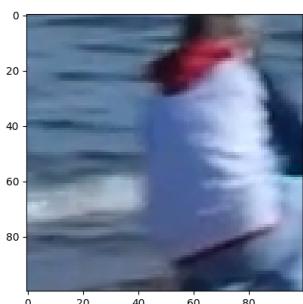
$x/2$

subsampling=4:1:1, divider=2.0



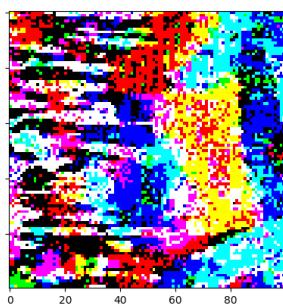
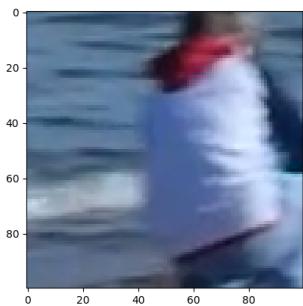
$x/4$

subsampling=4:1:1, divider=4.0



$x/8$

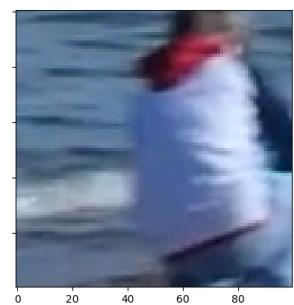
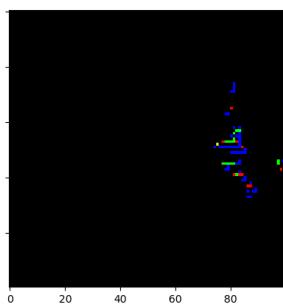
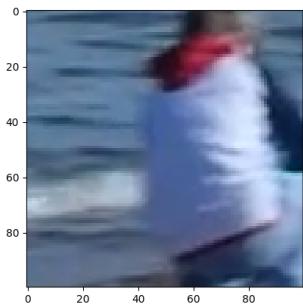
subsampling=4:1:1, divider=8.0



Subsampling 4:2:0

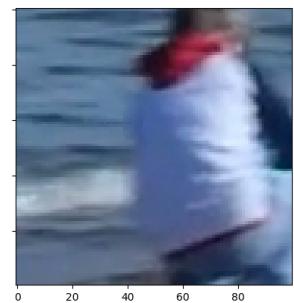
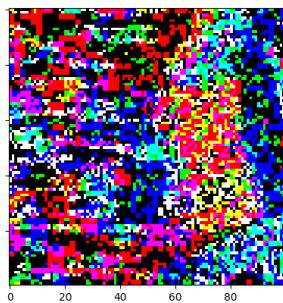
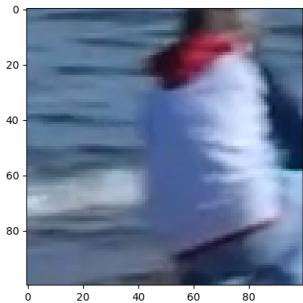
$x/1$

subsampling=4:2:0, divider=1.0



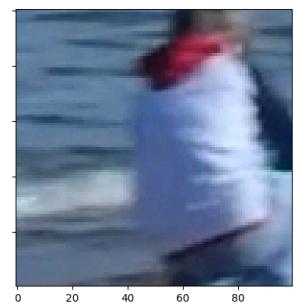
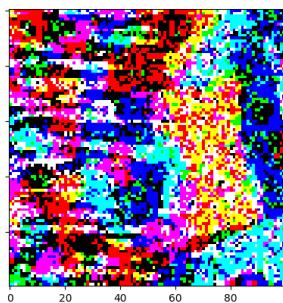
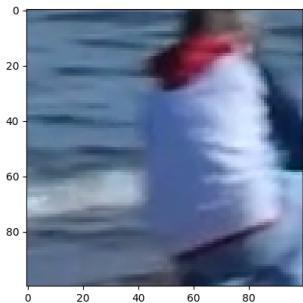
$x/2$

subsampling=4:2:0, divider=2.0



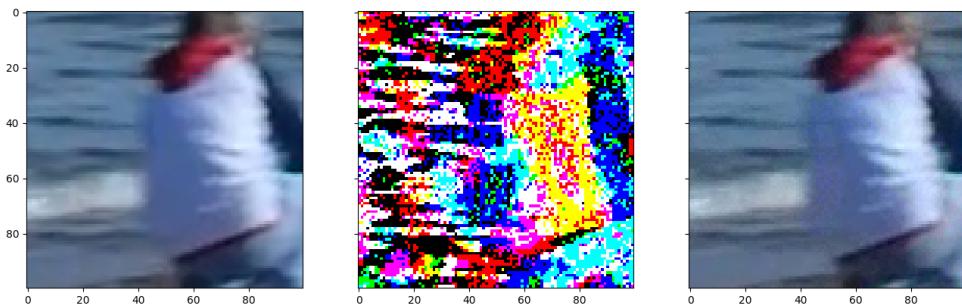
$x/4$

subsampling=4:2:0, divider=4.0



$x/8$

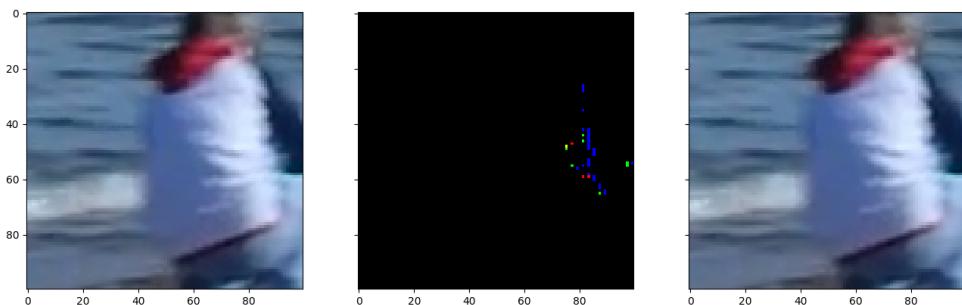
subsampling=4:2:0, divider=8.0



Subsampling 4:2:2

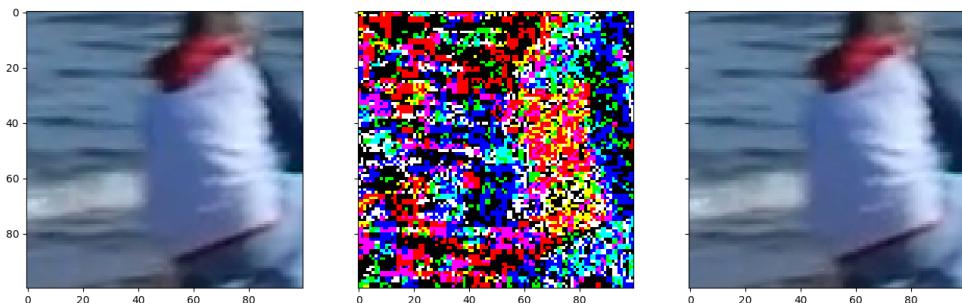
$x/1$

subsampling=4:2:2, divider=1.0



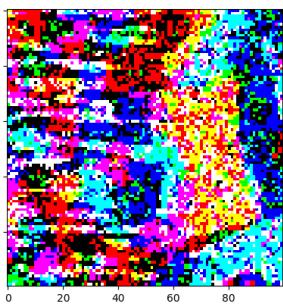
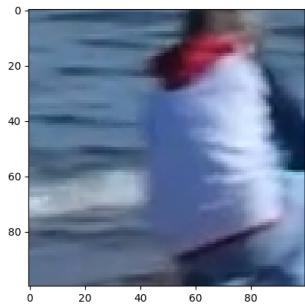
$x/2$

subsampling=4:2:2, divider=2.0



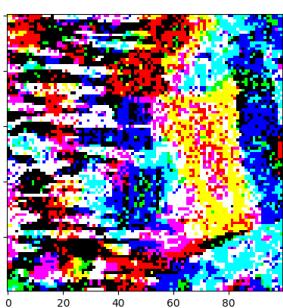
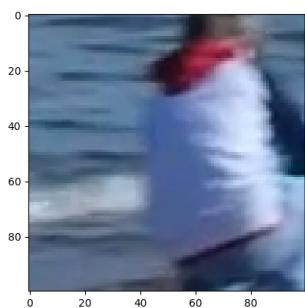
$x/4$

subsampling=4:2:2, divider=4.0



$x/8$

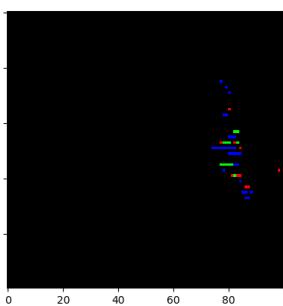
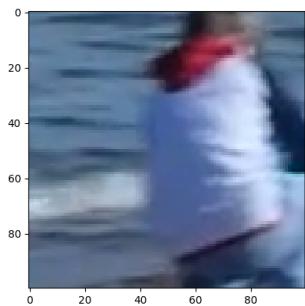
subsampling=4:2:2, divider=8.0



Subsampling 4:4:0

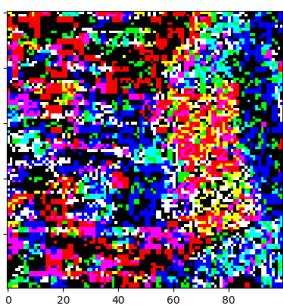
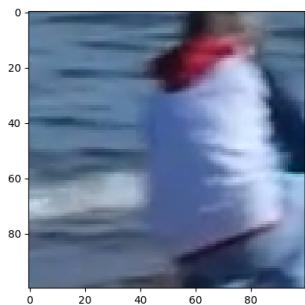
$x/1$

subsampling=4:4:0, divider=1.0



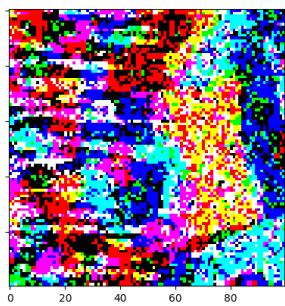
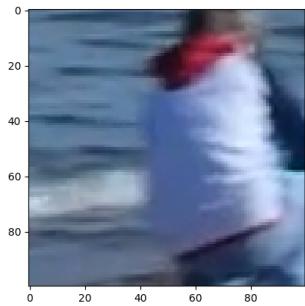
$x/2$

subsampling=4:4:0, divider=2.0



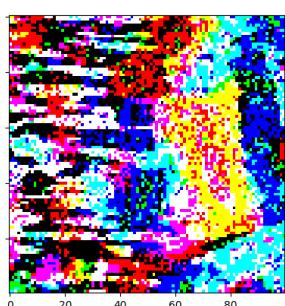
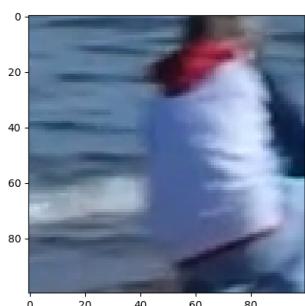
x/4

subsampling=4:4:0, divider=4.0



x/8

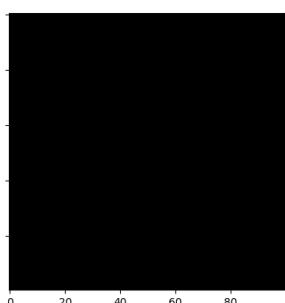
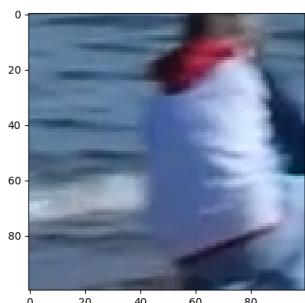
subsampling=4:4:0, divider=8.0



Subsampling 4:4:4

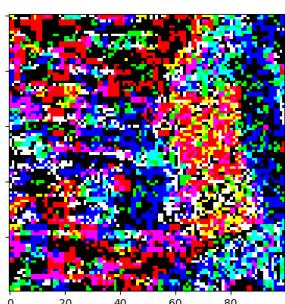
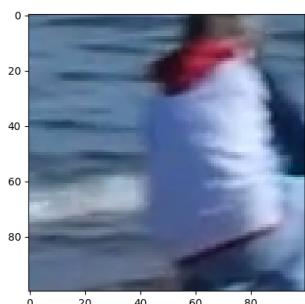
x/1

subsampling=4:4:4, divider=1.0

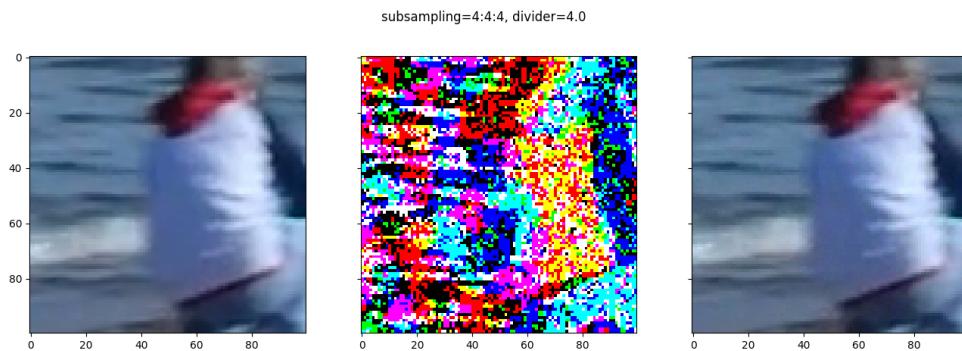


x/2

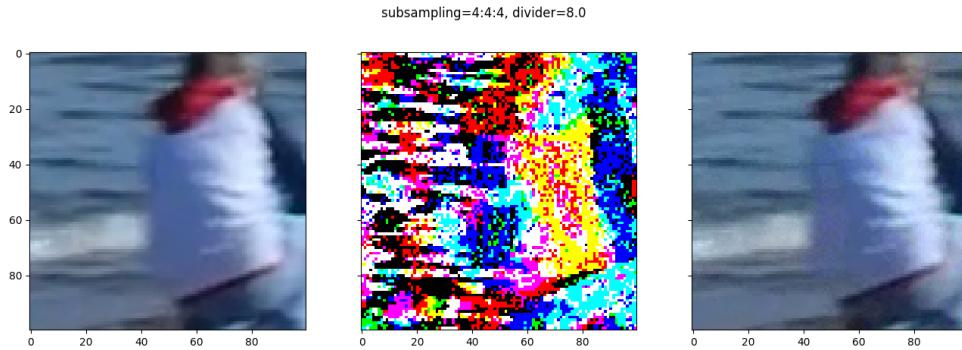
subsampling=4:4:4, divider=2.0



x/4



x/8



Wnioski:

- Zwykle subsampling nie ma dużego wpływu na różnice, mimo że są one łatwo zauważalne na środkowym obrazku to nie powodują one dużej różnicy w zdekompresowanej klatce.
- Wyjątkiem od tego jest subsampling 4:1:1 i 4:1:0 – różnią się one znacznie od pozostałych.
- Inaczej jest w przypadku obrazu w odcieniach szarości (clip_3) – wartości w pikselach w warstwach Cr i Cb są takie same więc subsampling nie powoduje utraty jakości. W tym klipie różnice są bardzo mało widoczne.
- W przypadku klatek w kolorowych filmach dzielenie powoduje powstanie dużo większych różnic, nawet w przypadku dzielenia przez 2.
- Różnice między dzieleniem przez 4 i 8 ciężko zauważać na obrazku z różnicami. Widać ją dopiero przyglądając się na przemian oryginalnej i zdekompresowanej klatce.
- Różnice między dzieleniem przez 2 i 4 nie są aż tak widoczne.
- Zwykle obrazek z różnicami w kolorach (środkowy) nie jest zbyt miarodajny, znacznie lepiej samodzielnie porównać i ocenić klatkę oryginalną ze zdekompresowaną.
- Różnice byłyby znacznie mniejsze gdyby nie konwertować danych po podzieleniu na int, ale to mijałoby się z celem.

Część 2:

Wybrany film: clip_4

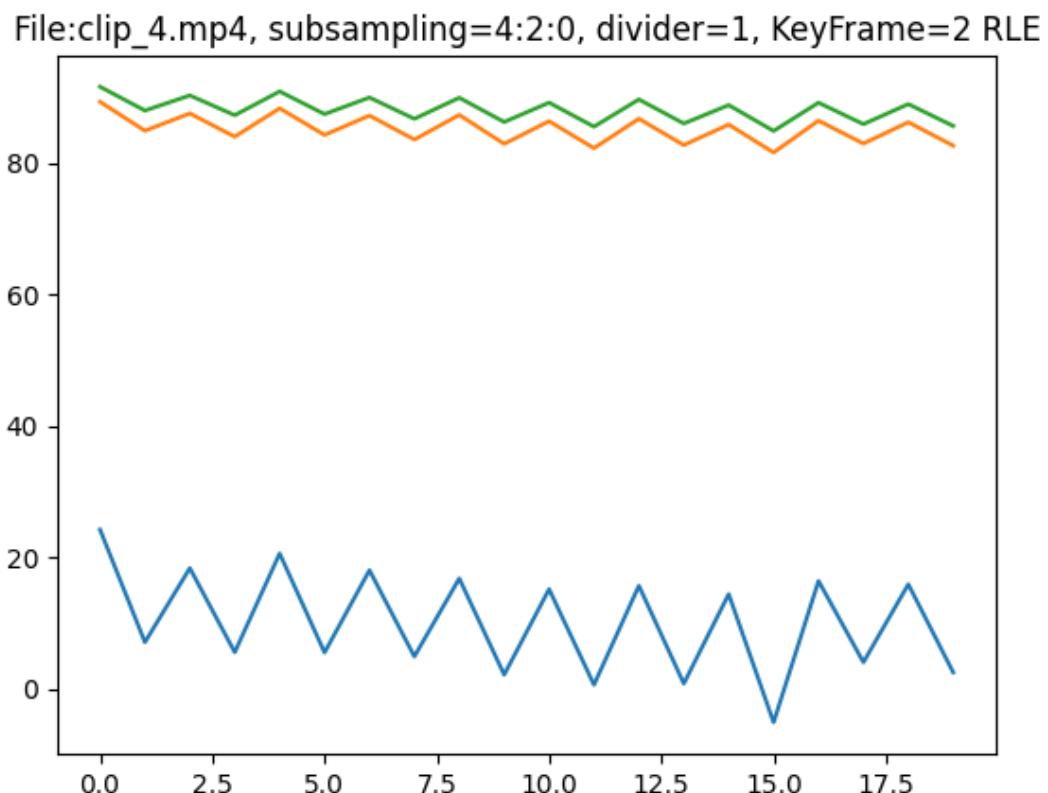
Wybrany subsampling: 4:2:0

Wybrany dzielnik: 1

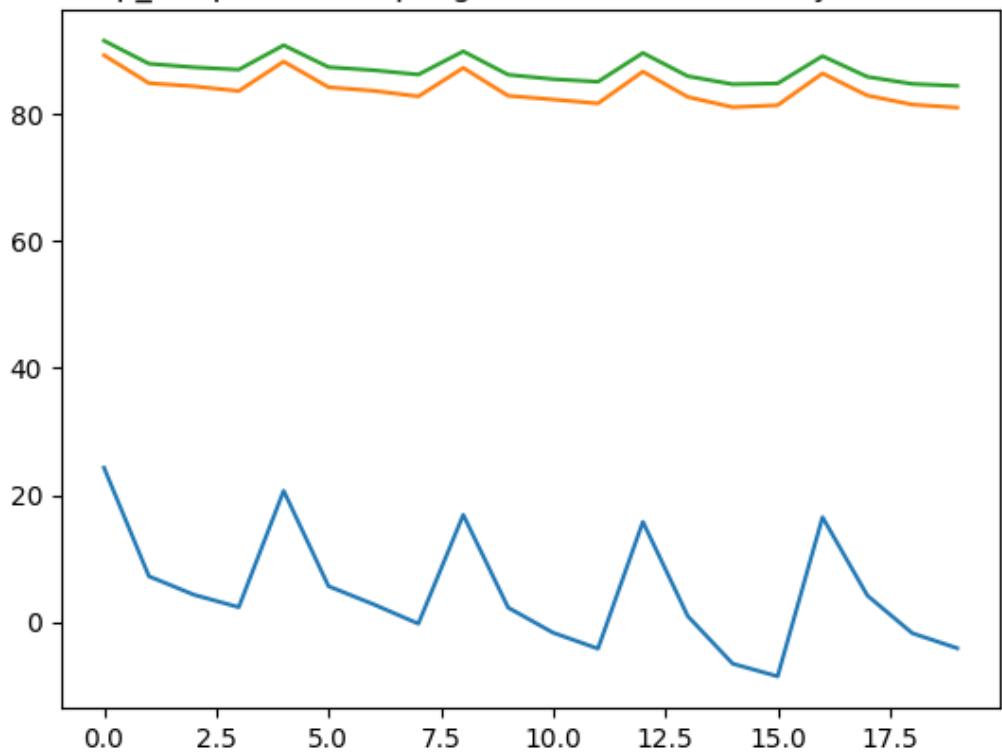
(ciężko wybrać najlepsze ustawienia, różnice między klatką oryginalną a zdekompresowaną są zawsze bardzo mało widoczne (oprócz dzielnika = 8), więc przy wyborze kierowałem się obrazkiem różnicowym i korzyścią w zmniejszeniu ilości zajmowanego miejsca po kompresji)

Wybrany algorytm: RLE

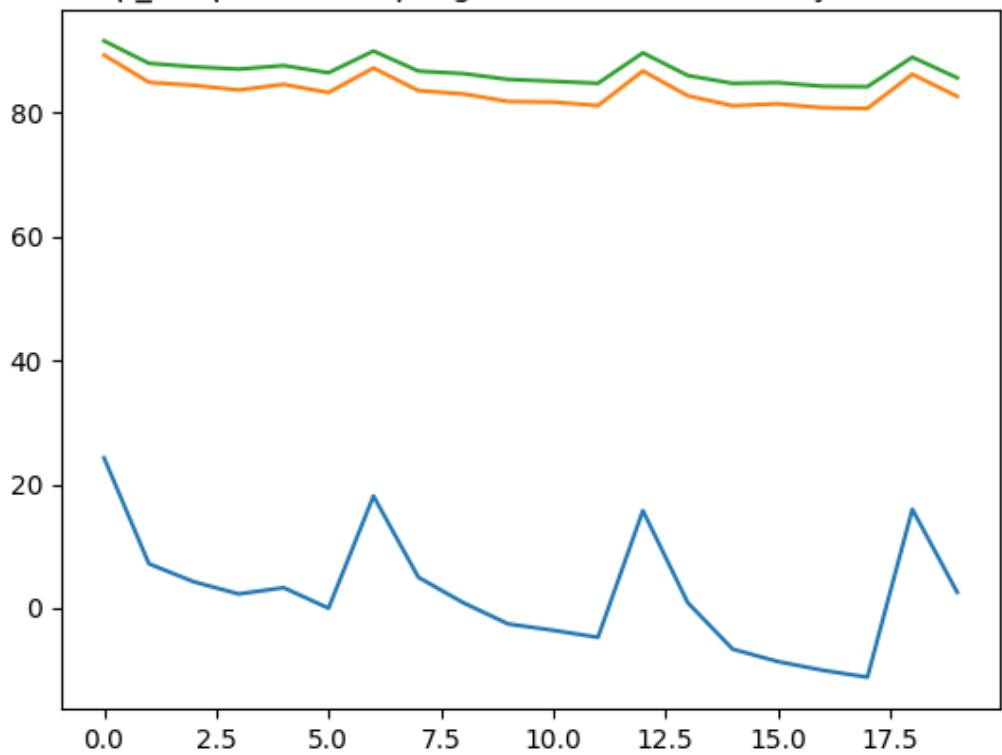
Odległość między klatkami kluczowymi (2, 4, 6, 8, 12, 14):



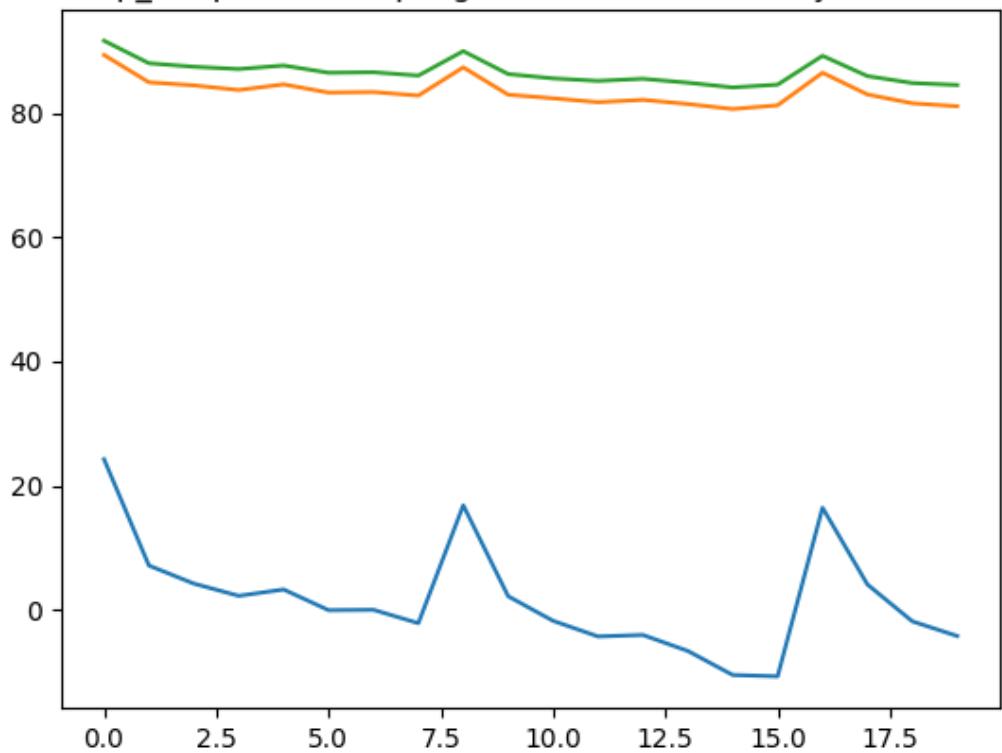
File:clip_4.mp4, subsampling=4:2:0, divider=1, KeyFrame=4 RLE



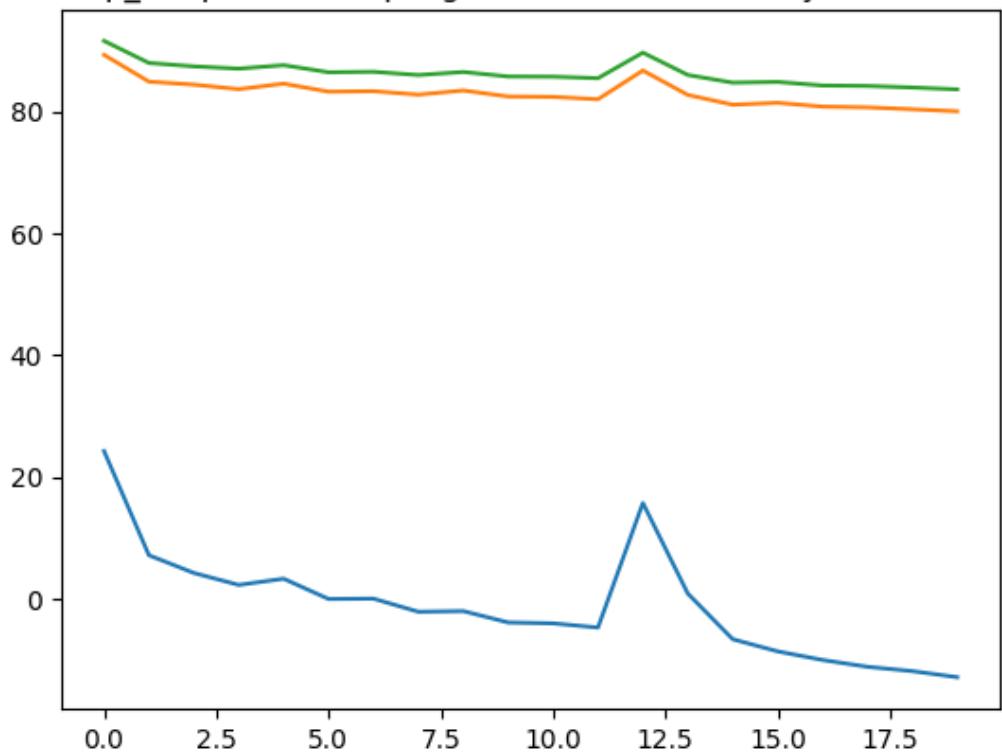
File:clip_4.mp4, subsampling=4:2:0, divider=1, KeyFrame=6 RLE



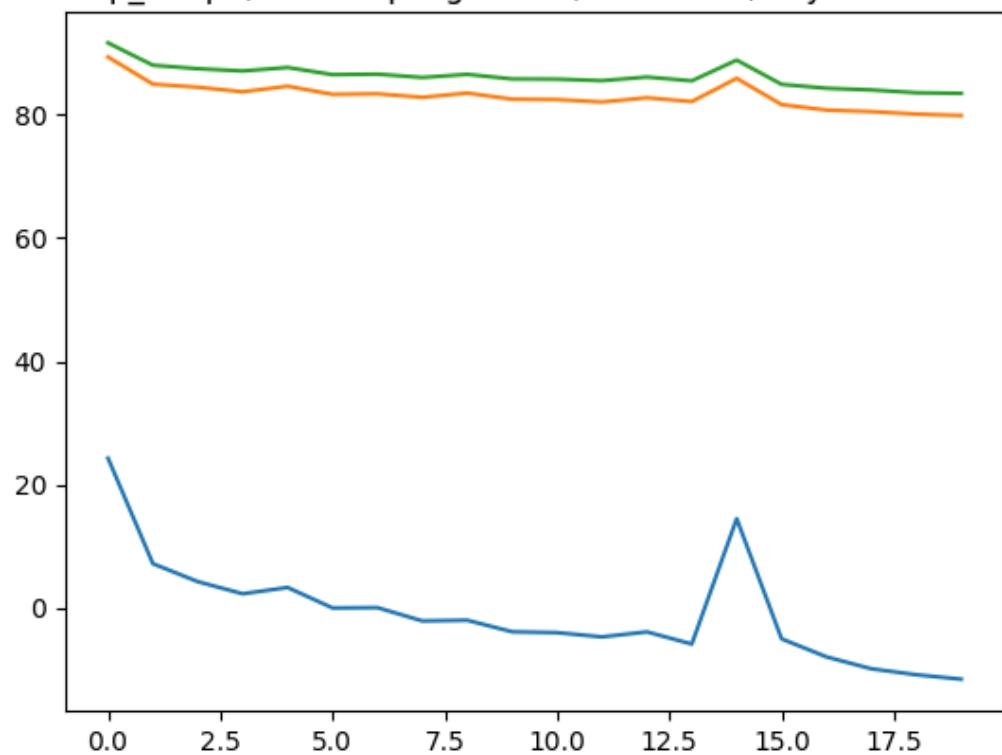
File:clip_4.mp4, subsampling=4:2:0, divider=1, KeyFrame=8 RLE



File:clip_4.mp4, subsampling=4:2:0, divider=1, KeyFrame=12 RLE



File:clip_4.mp4, subsampling=4:2:0, divider=1, KeyFrame=14 RLE

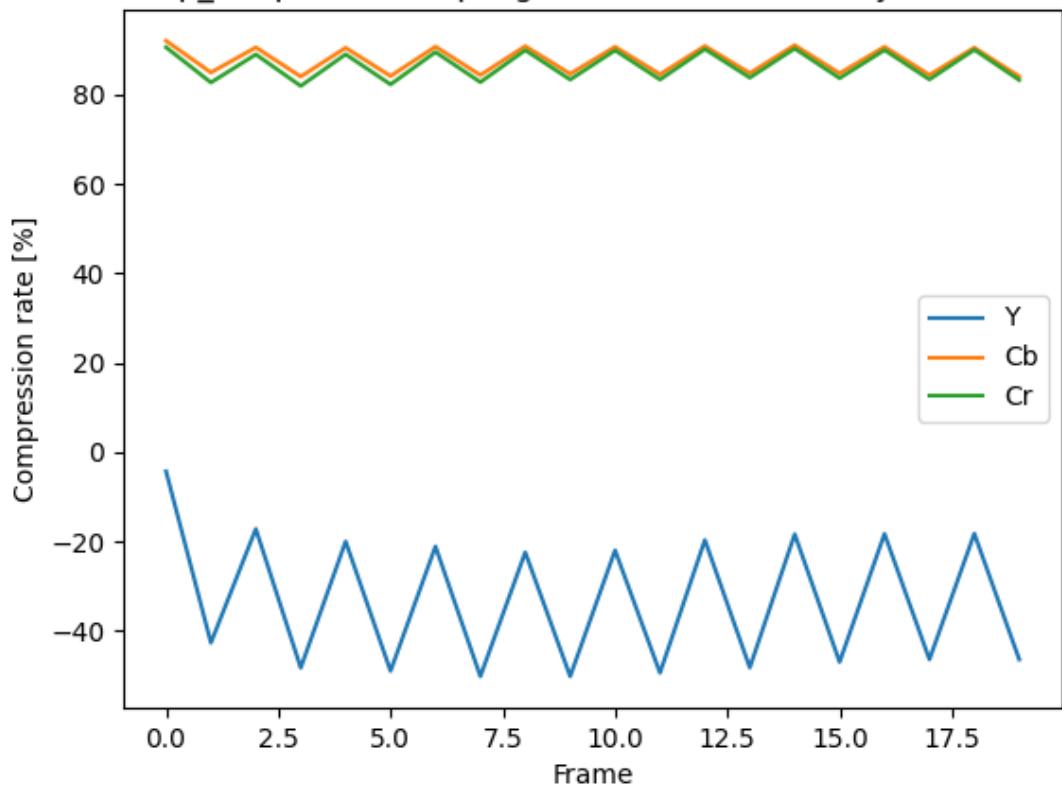


Wnioski:

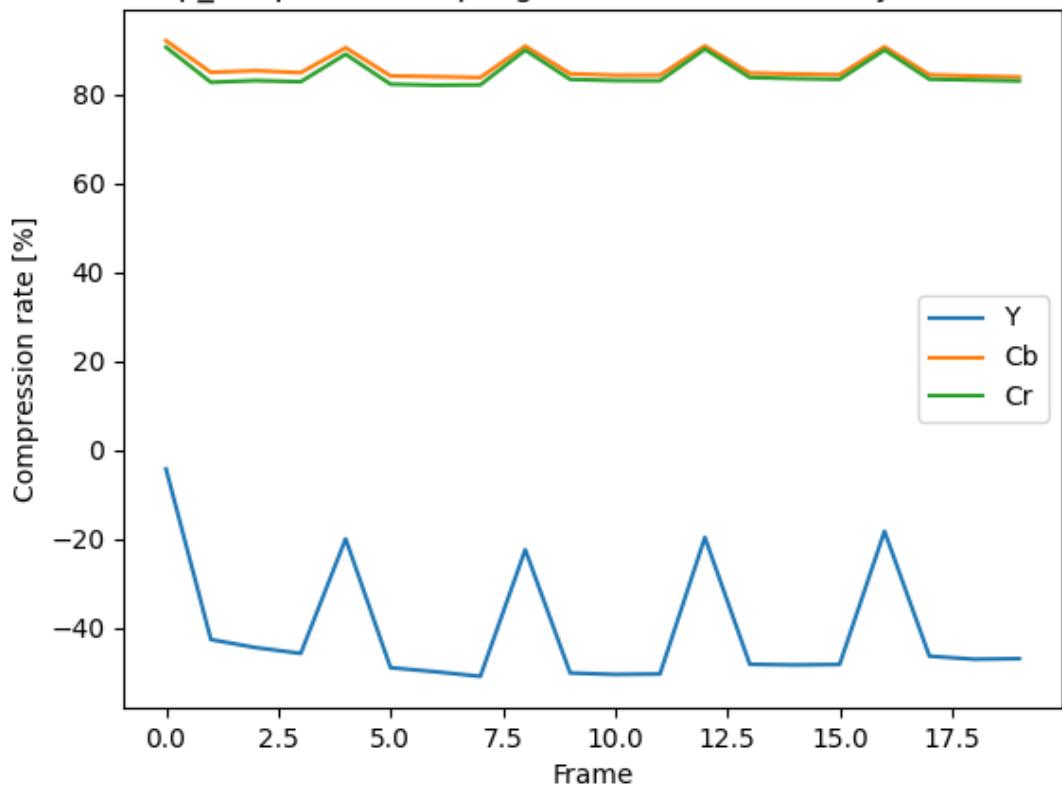
- Im większa odległość między klatkami kluczowymi tym kompresja jest mniejsza.
- W przypadku luminacji opłaca się używać kompresji strumieniowej jedynie dla klatek kluczowych, w przypadku klatek niekluczowych korzyść jest zbyt mała, w niektórych przypadkach można zaobserwować nawet wzrost rozmiaru tej warstwy.
- Wybrałbym odległość 2 lub 4 w przypadku reszty zysk byłby prawdopodobnie znikomy (biorąc pod uwagę cały film).
- Ze względu na stosowanie subsamplingu zmniejszenie się rozmiaru warstw Cr i Cb jest znacznie większe niż warstwy Y.

Uruchomiłem clip_5 z tymi samymi ustawieniami – wyniki dla warstwy Cr i Cb są podobne, natomiast dla warstwy Y są one znacznie gorsze z powodu częstszych zmian na niej występujących. W tym przypadku nie opłaca się przeprowadzać kompresji strumieniowej nawet na klatkach kluczowych.

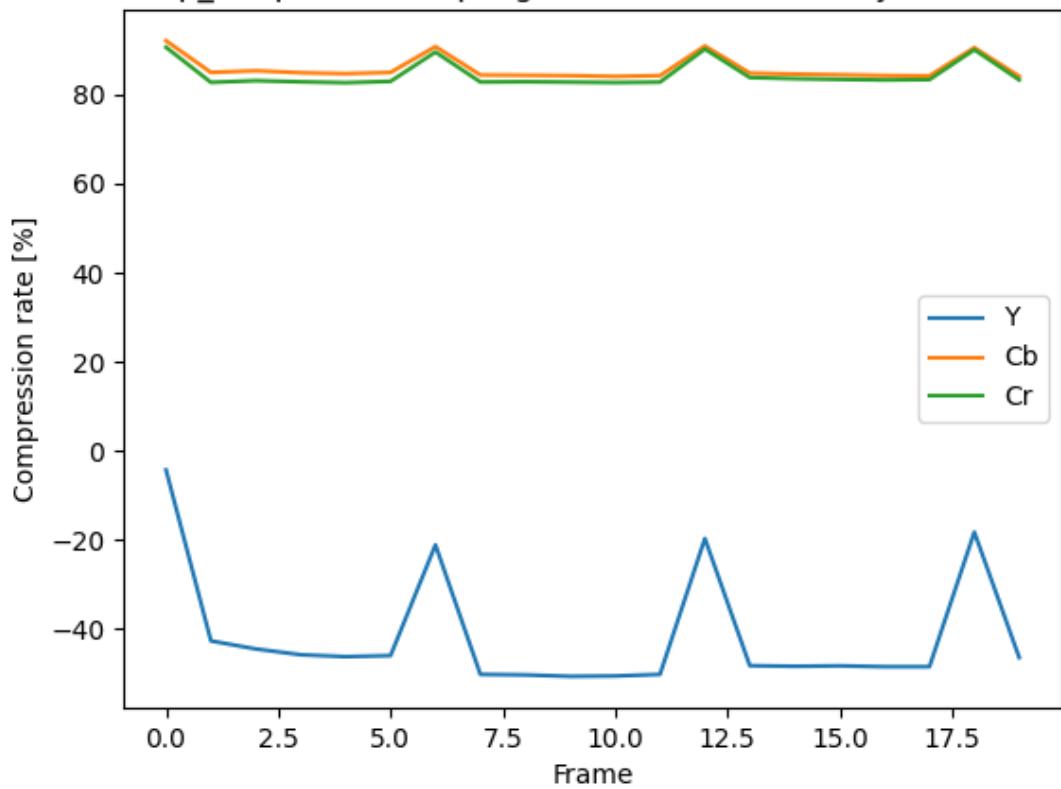
File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=2 RLE



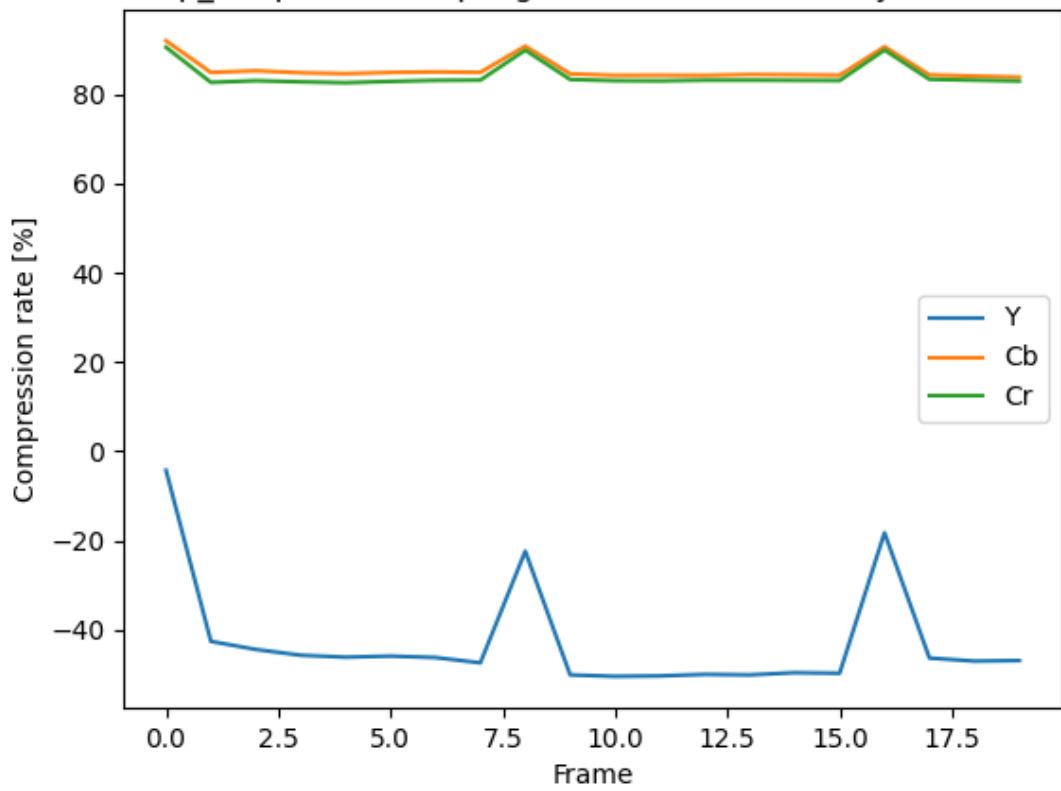
File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=4 RLE



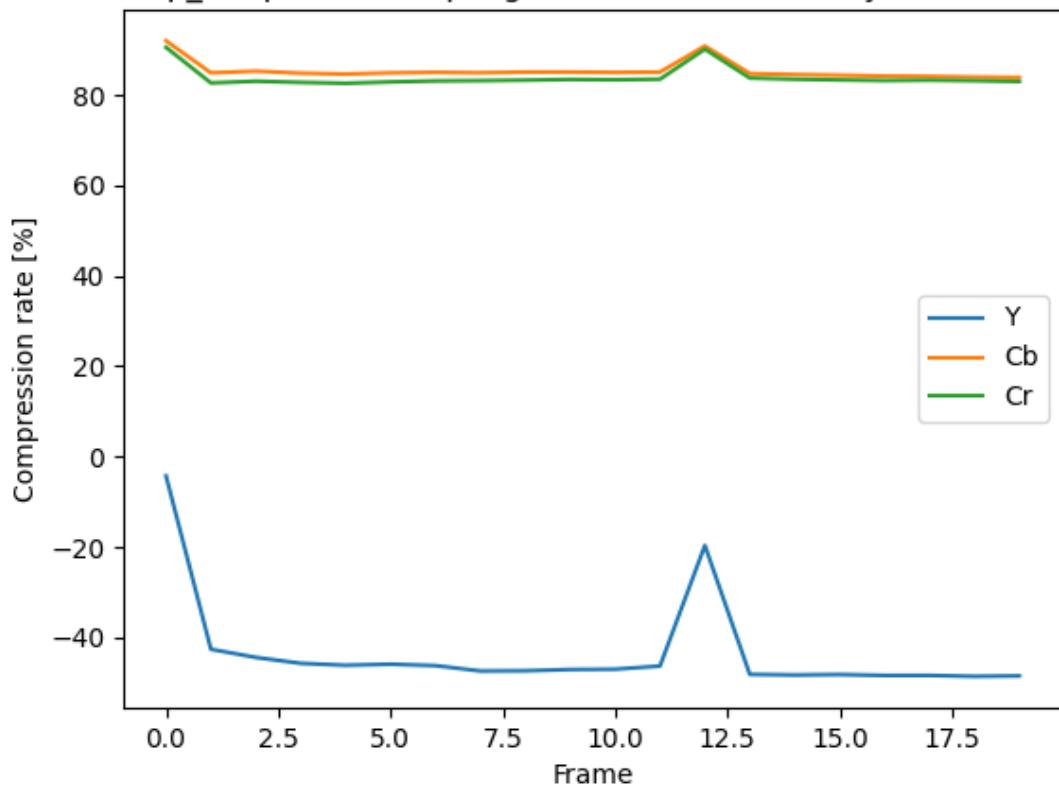
File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=6 RLE



File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=8 RLE



File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=12 RLE



File:clip_5.mp4, subsampling=4:2:0, divider=1, KeyFrame=14 RLE

