



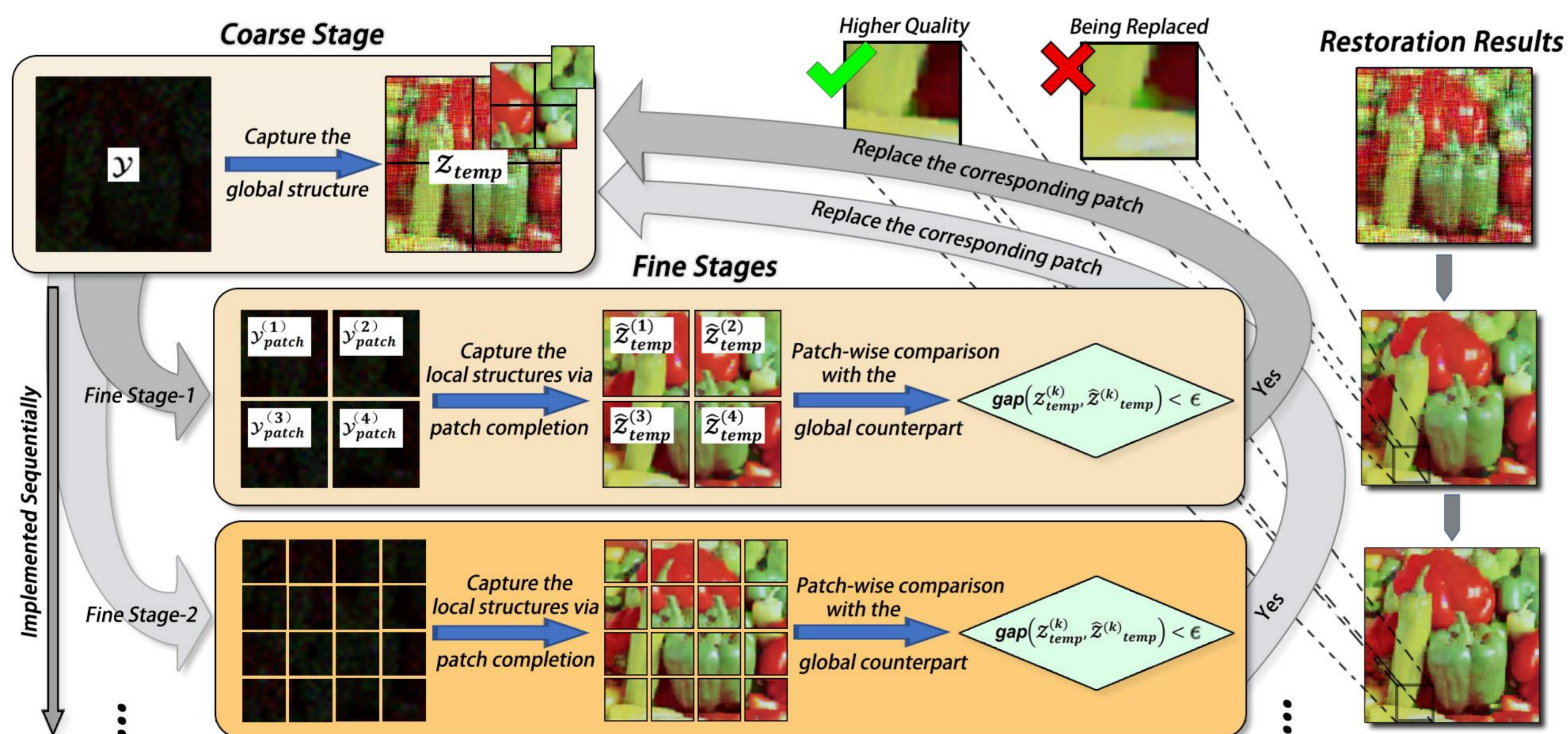
Introduction



Although LRTC breaks through the limitation of relying only on the observed adjacent pixels and adopts a global low-rank assumption on the completed image, we find the global low-rank setting embodies a tradeoff between restoring the originally low-rank parts and neglecting the potentially high-rank parts. The tradeoff depicted in figure above, brings about two issues:

- 1) The restoration of the parts associated with a lower local rank will be hindered with insufficient observed pixels.
- 2) The potentially high-rank complex objects will suffer the loss of details due to over-smoothing.

Methods



Results



The C2F strategy helps LRTC methods to restore more details.

| | 0.7 | | 0.8 | | 0.9 | | | 0.7 | | 0.8 | | 0.9 | |
|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | PSNR | RSE | PSNR | RSE | PSNR | RSE | | PSNR | RSE | PSNR | RSE | PSNR | RSE |
| Airplane | | | | | | | Baboon | | | | | | |
| HaLRTC | 24.50 | 0.074 | 21.97 | 0.099 | 18.97 | 0.140 | HaLRTC | 21.94 | 0.148 | 20.48 | 0.175 | 18.60 | 0.220 |
| C2F-HaLRTC | 24.76 | 0.072 | 22.26 | 0.096 | 19.45 | 0.133 | C2F-HaLRTC | 22.16 | 0.144 | 20.69 | 0.171 | 18.62 | 0.217 |
| STDC | 22.77 | 0.090 | 18.67 | 0.145 | 15.25 | 0.236 | STDC | 17.19 | 0.256 | 16.50 | 0.277 | 14.48 | 0.350 |
| C2F-STDC | 23.39 | 0.086 | 21.16 | 0.137 | 20.13 | 0.123 | C2F-STDC | 20.19 | 0.176 | 19.50 | 0.197 | 17.19 | 0.256 |
| LRTC-TV-II | 26.91 | 0.056 | 27.33 | 0.068 | 22.80 | 0.098 | LRTC-TV-II | 23.30 | 0.129 | 22.32 | 0.143 | 21.22 | 0.165 |
| C2F-LRTC-TV-II | 27.84 | 0.051 | 27.35 | 0.067 | 23.28 | 0.085 | C2F-LRTC-TV-II | 23.47 | 0.126 | 22.52 | 0.141 | 23.05 | 0.161 |
| LRTC-PDS | 25.42 | 0.072 | 23.55 | 0.089 | 20.72 | 0.144 | LRTC-PDS | 23.17 | 0.136 | 22.07 | 0.154 | 20.72 | 0.245 |
| C2F-LRTC-PDS | 25.79 | 0.066 | 23.83 | 0.084 | 21.15 | 0.140 | C2F-LRTC-PDS | 23.25 | 0.131 | 22.15 | 0.150 | 20.75 | 0.239 |
| Barbara | | | | | | | Facade | | | | | | |
| HaLRTC | 25.27 | 0.112 | 22.65 | 0.151 | 19.06 | 0.229 | HaLRTC | 28.58 | 0.083 | 26.09 | 0.110 | 22.57 | 0.144 |
| C2F-HaLRTC | 25.72 | 0.106 | 22.87 | 0.147 | 19.26 | 0.223 | C2F-HaLRTC | 29.74 | 0.063 | 27.54 | 0.081 | 24.87 | 0.111 |
| STDC | 22.04 | 0.162 | 19.84 | 0.209 | 16.28 | 0.315 | STDC | 26.54 | 0.091 | 24.54 | 0.115 | 20.95 | 0.153 |
| C2F-STDC | 22.17 | 0.160 | 20.90 | 0.207 | 20.41 | 0.196 | C2F-STDC | 26.64 | 0.090 | 24.56 | 0.114 | 22.62 | 0.143 |
| LRTC-TV-II | 27.88 | 0.085 | 26.06 | 0.100 | 23.87 | 0.131 | LRTC-TV-II | 27.19 | 0.092 | 25.76 | 0.099 | 21.79 | 0.158 |
| C2F-LRTC-TV-II | 28.46 | 0.078 | 26.69 | 0.097 | 24.75 | 0.119 | C2F-LRTC-TV-II | 27.89 | 0.068 | 25.80 | 0.091 | 24.40 | 0.117 |
| LRTC-PDS | 26.86 | 0.107 | 25.13 | 0.132 | 22.13 | 0.185 | LRTC-PDS | 24.01 | 0.130 | 22.21 | 0.159 | 19.93 | 0.246 |
| C2F-LRTC-PDS | 27.00 | 0.098 | 25.38 | 0.124 | 22.34 | 0.178 | C2F-LRTC-PDS | 24.41 | 0.123 | 22.58 | 0.153 | 20.09 | 0.239 |
| House | | | | | | | Lena | | | | | | |
| HaLRTC | 25.79 | 0.084 | 23.72 | 0.107 | 20.54 | 0.154 | HaLRTC | 25.86 | 0.093 | 23.19 | 0.125 | 19.77 | 0.185 |
| C2F-HaLRTC | 25.92 | 0.830 | 24.07 | 0.103 | 21.05 | 0.145 | C2F-HaLRTC | 25.99 | 0.091 | 23.28 | 0.124 | 20.15 | 0.177 |
| STDC | 24.28 | 0.100 | 22.50 | 0.123 | 17.54 | 0.218 | STDC | 23.22 | 0.125 | 20.45 | 0.171 | 16.64 | 0.266 |
| C2F-STDC | 24.73 | 0.095 | 22.88 | 0.118 | 21.91 | 0.132 | C2F-STDC | 22.64 | 0.118 | 21.56 | 0.169 | 20.84 | 0.164 |
| LRTC-TV-II | 28.27 | 0.065 | 27.37 | 0.074 | 24.99 | 0.094 | LRTC-TV-II | 29.62 | 0.059 | 27.52 | 0.072 | 25.36 | 0.097 |
| C2F-LRTC-TV-II | 28.34 | 0.064 | 27.40 | 0.073 | 25.37 | 0.088 | C2F-LRTC-TV-II | 30.04 | 0.058 | 27.92 | 0.070 | 25.51 | 0.095 |
| LRTC-PDS | 27.19 | 0.075 | 25.63 | 0.096 | 22.77 | 0.146 | LRTC-PDS | 28.48 | 0.086 | 26.39 | 0.106 | 22.40 | 0.141 |
| C2F-LRTC-PDS | 27.30 | 0.066 | 25.74 | 0.089 | 22.85 | 0.142 | C2F-LRTC-PDS | 28.55 | 0.077 | 26.49 | 0.099 | 22.46 | 0.135 |
| Peppers | | | | | | | Sailboat | | | | | | |
| HaLRTC | 22.82 | 0.132 | 20.31 | 0.176 | 16.86 | 0.262 | HaLRTC | 22.78 | 0.127 | 20.60 | 0.164 | 17.81 | 0.226 |
| C2F-HaLRTC | 23.59 | 0.121 | 20.72 | 0.168 | 16.86 | 0.261 | C2F-HaLRTC | 23.09 | 0.123 | 20.87 | 0.159 | 17.93 | 0.223 |
| STDC | 21.37 | 0.156 | 18.61 | 0.214 | 16.31 | 0.347 | STDC | 20.58 | 0.184 | 18.10 | 0.245 | 14.87 | 0.317 |
| C2F-STDC | 21.48 | 0.154 | 20.64 | 0.210 | 18.42 | 0.219 | C2F-STDC | 20.85 | 0.178 | 18.23 | 0.185 | 19.12 | 0.194 |
| LRTC-TV-II | 27.75 | 0.076 | 25.25 | 0.103 | 22.04 | 0.144 | LRTC-TV-II | 25.21 | 0.103 | 23.42 | 0.118 | 20.67 | 0.162 |
| C2F-LRTC-TV-II | 28.37 | 0.072 | 26.17 | 0.096 | 23.46 | 0.122 | C2F-LRTC-TV-II | 26.61 | 0.092 | 23.76 | 0.112 | 21.61 | 0.146 |
| LRTC-PDS | 27.05 | 0.102 | 24.06 | 0.131 | 20.09 | 0.194 | LRTC-PDS | 23.95 | 0.123 | 22.13 | 0.153 | 19.37 | 0.209 |
| C2F-LRTC-PDS | 27.33 | 0.092 | 24.31 | 0.122 | 20.35 | 0.188 | C2F-LRTC-PDS | 24.33 | 0.117 | 22.46 | 0.147 | 19.58 | 0.205 |

It can be observed that under all missing ratios, the performance of every pure LRTC method is enhanced after employing the C2F strategy. In other words, C2F-LRTC can restore images with large PSNR and smaller RSE values.

Conclusions

- 1) A general and intuitive C2F strategy is proposed, which effectively enhances the performance of existing LRTC methods by seeking proper local ranks for both the low- and high-rank parts, respectively.
- 2) No more trade-off that aims to balance the restoration performance of simple and complex parts is required.
- 3) Utilization of the data from both coarse and fine hierarchies, thus capturing both the global and local data structure simultaneously.

