Evolisa challenge: an image is to be approximated using artistic elements (such as brushstrokes).

New tiled image evolution approaches:
- Following 5 methods were developed:
  1. blending filled triangles and jDE,
  2. blending filled triangles and canonical DE with $F = 0.5$, $CR = 0.9$,
  3. filled triangles without blending, jDE,
  4. empty triangles without blending, jDE,
  5. lines between first two encoded points instead of a triangle, jDE.

These methods are tested on different classes of experiments:
- class 1: setting MAXFES to 1e+6 (base class);
- class 2: setting MAXFES to 1e+8 and only running with the best settings $T_{max}$, $R_s = R_g$ where a best setting was found at the base class (1) experiment, and also $R_s = R_g = 100$ for that $T_{max}$; and
- class 3: setting parameter $N_P$ initially at 500 and halving it through 4 population reductions, while keeping the rest same as for class 2 (in order to also study the parameter $N_P$).

Method & Contributions
- Using differential evolution (DE) optimization algorithm, a lossy image representation with variable number of brushstrokes is evolved.
  - Several different methods to represent or combine a brushstroke on an image canvas.
  - Including the control parameters of the proposed methods.
  - An image is filled equidistantly and a DE is run on each tile separately.
  - The proposed blending joins multiple brushstrokes over several pixels,
  - While gene compression strives to select only the effective part of the potential full genome,
  - It selects the rendered codon with a limited subset number of brushstrokes.

The difficulty increased significantly exponentially with FES – for all methods, when requiring smaller RN (residual noise) degree to attain.

The results show that different proposed algorithms differ significantly in performance, but through a prolonged evolution they all obtain evolved images fairly closely resembling the reference images, which was not demonstrated yet at any previous Evolisa experiments (previously, merely down to 5%-10% results were reported).

Results

![The evolved and the reference images.](image)

![Combined convergences on test images for different algorithms, aligned on FES.](image)

![Convergences on test images for different methods (experiments class 2).](image)

Background – Differential Evolution (DE)

Three DE operators:
- mutation (Eq. (1)),
- crossover (Eq. (2)),
- selection (Eq. (3)).


Encoding & Fitness Function

Gene compression:
- variable $T_i$ (Eq. (4)).

Fitness (Eqs. (8),(9)): blending & reference image comparison.

References