Introduction

MAP-Elites (Multi-dimensional Archive of Phenotypic Elites [1]) is a quality diversity algorithm, meaning that it collects a diverse archive of quality solutions to a problem. We used MAP-Elites to evolve flying machines in Minecraft [2]. These structures are collections of blocks that move perpetually in one direction forever using pistons and other components. The quality diversity approach was more effective than evolutionary computation using fitness alone.

MAP-Elites

- Generates various shapes, to store in an archive
- Shapes are categorized into specific bins in the archive, and scored using a fitness function
- Each bin can only hold one shape.
- More-fit shapes replace less-fit shapes in a given bin and stay in archive

Experiment and Results

- Experiments were done with two block sets: original block set [2], observer block set (adds observer block)
- Compared PF to several binning schemes
- PF was comparable to ME.C and ME.CN
- More successful runs using the observer block set
- Success rates compared using Fisher's exact tests
- ME.PO produced a machine for each direction
- ME.PO produced more variation in flying machines
- ME.PO is statistically significantly more successful when using both block sets (p < 0.05)

Quality/Fitness Function

- The Fitness Function is the accumulated change in the center of mass as the shape moves during evaluation
- Periodic checks: compare last and current center
- Special case: if most blocks leave the area being observed, the shape is assumed to have flown away
- Definite flying machines get a maximum fitness minus a small penalty for any remaining blocks.

References