

Massively Parallel Layout Generation In Real Time

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Figure 1: Left image is the input layout; five images on the right show layouts produced by our method

ABSTRACT

Conceiving an artwork requires designers to create assets and organize (or layout) them in a harmonious, self-organizing story. While creativity is fundamental to both aspects, the latter can be bolstered with automated techniques. We present a first true SIMD formulation for the layout generation and leverage CUDA-enabled GPU to scan through millions of possible permutations and rank them on aesthetic appeal using weighted parameters such as symmetry, alignment, density, size balance, etc. The entire process happens in real-time using a GPU-accelerated implementation of replica exchange Monte Carlo Markov Chain method. The exploration of design space is rapidly narrowed by performing distant jumps from poorly ranked layouts, and fine tuning the highly ranked ones. Several iterations are carried out until desired rank or system convergence is achieved. In contrast to existing approaches, our technique generates aesthetically better layouts and runs more than two orders of magnitude faster.

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CCS CONCEPTS

• **Computing methodologies** → *Image-based rendering*;

KEYWORDS

Graphic Design, Page Layout, 2D arrangements

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1 INTRODUCTION

Optimally arranging a set of objects in a given space finds applications in several domains. Among others, researchers have examined furniture layout in 3D space [Merrell et al. 2011; Yu et al. 2011] and graphic asset layout in 2D space [O'Donovan et al. 2015]. Prior art, however, points to similar observations and problems. The most prominent one being the inordinately large size of search space (of arrangements), which is computationally prohibitive to fully explore. At the same time, relevant literature finds randomized search space exploration with Monte Carlo Markov Chain [Hastings 1970] methods particularly suitable. Such methods involve optimizing a cost function that measures a layout on a predefined set of weighted parameters (for example, symmetry and balance of a page layout in our case). However, there are two subtle concerns; first, evaluating a layout should be inexpensive and second, on instantiating a poor

