Interest Curves

Concept, Evaluation, Implementation and Applications

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Abstract
Image features play important roles in a wide range of computer vision applications, such as image registration, 3D reconstruction, object detection and video understanding. These image features include edges, contours, corners, regions, lines, curves, interest points, etc. However, the research is fragmented in these areas, especially when it comes to line and curve detection. In this thesis, we aim to discover, integrate, evaluate and summarize past research as well as our contributions in the area of image features. This thesis provides a comprehensive framework of *concept*, *evaluation*, *implementation*, and *applications* for image features.

Firstly, this thesis proposes a novel concept of interest curves. Interest curves is a concept derived and extended from interest points. Interest curves are significant lines and arcs in an image that are repeatable under various image transformations. Interest curves bring clear guidelines and structures for future curve and line detection algorithms and related applications.

Secondly, this thesis presents an evaluation framework for detecting and describing interest curves. The evaluation framework provides a new paradigm for comparing the performance of state-of-the-art line and curve detectors under image perturbations and transformations.

Thirdly, this thesis proposes an interest curve detector (Distinctive Curves, *DICU*), which unifies the detection of edges, corners, lines and curves. DICU represents our state-of-the-art contribution in the areas concerning the detection of edges, corners, curves and lines. Our research efforts cover the most important attributes required by these features with respect to robustness and efficiency.

Interest curves preserve richer geometric information than interest points. This advantage gives new ways of solving computer vision problems. We propose a simple description method for curve matching applications. We have found that our proposed interest curve descriptor outperforms all state-of-the-art interest point descriptors (SIFT, SURF, BRISK, ORB, FREAK). Furthermore, in our research we design a novel object detection algorithm that only utilizes DICU geometries without using local feature appearance. We organize image objects as curve chains and to detect an object, we search this curve chain in the target image using dynamic programming. The curve chain matching is scale and rotation-invariant as well as robust to image deformations. These properties have given us the possibility of resolving the rotation-variance problem in object detection applications. In our face detection experiments, the curve chain matching method proves to be scale and rotation-invariant and very computational efficient.

Keywords
scale-invariant, edge, corner, curve, line, matching, object detection.

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