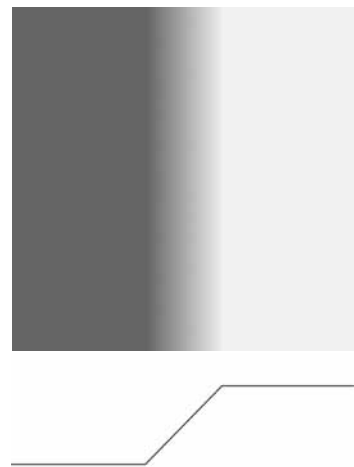
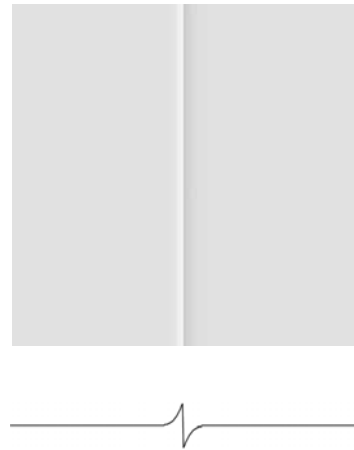
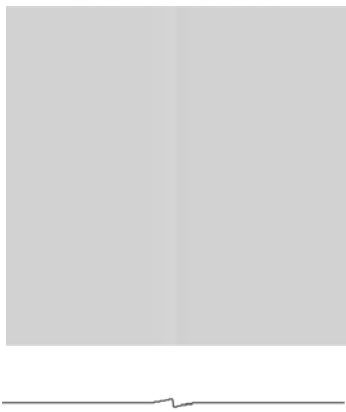


脳情報学4:
視覚の計算論

ATR脳情報研究所

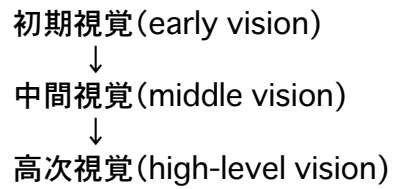
川人光男





視覚の役割

2次元画像から外界の3次元構造を推測すること



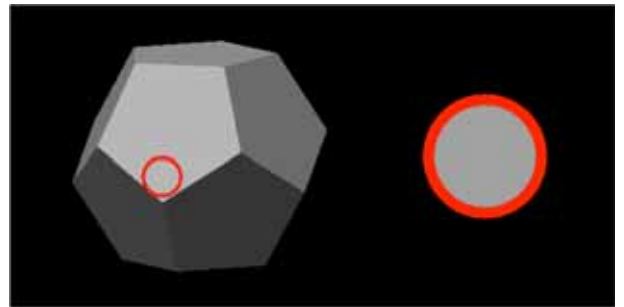
視覚の不良設定性

良設定問題

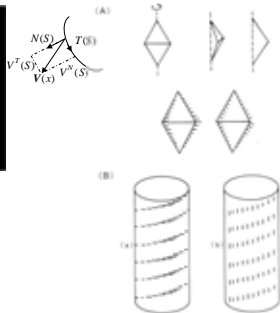
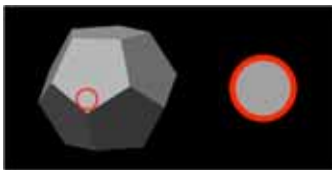
- (1) 問題の解が存在し
- (2) 解が一意であり
- (3) 解がデータに連続に依存する

光学 3次元空間 → 2次元画像
視覚 (逆光学) 2次元画像 → 3次元空間

:不良設定性



Contour Based Optical Flow (Hildreth)



Within the aperture, only motion component perpendicular to the contour can be measured.

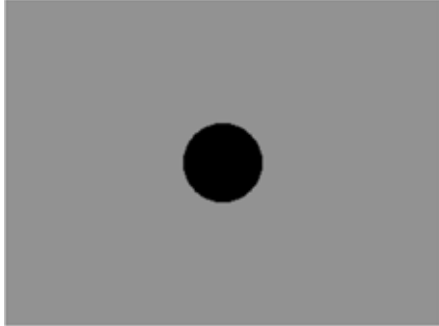
How to determine velocity vector?

V

$$\|V \cdot N - V^N\|^2 + \lambda \int \left(\frac{\partial V}{\partial s} \right)^2 ds$$

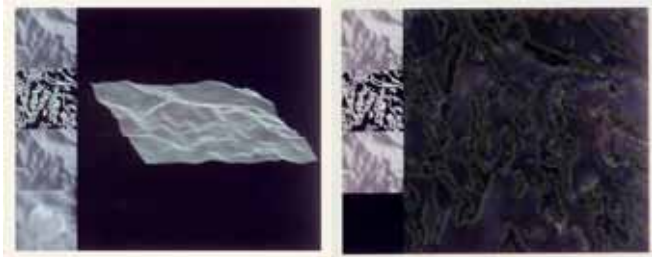
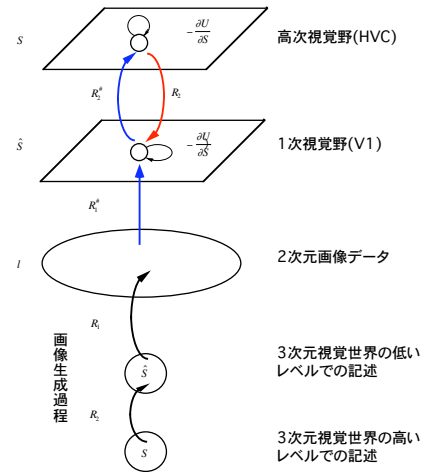
Smoothness of the velocity field





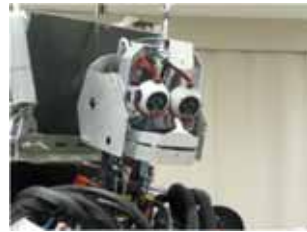
一次視覚野と高次視覚野とで構成される階層構造の基本計算モデル

一次視覚野では、高次視覚野の表現と2次元画像データとの中間的な表現が処理される。これに対応して画像生成過程は、高いレベルでの記述から低いレベルでの記述へのと、低いレベルでの記述から2次元画像データへのとの直列計算で表せる。



Humanoid Vision

- Optical system with foveated vision (high definition only in the center)
- Biomimetic motor control: capture targets accurately on the fovea, dealing with delays, active stereo vision



CB-i



i-1

Benefits of foveated vision



Object recognition on a humanoid head

Based on the capabilities of a humanoid visual system with foveated vision, we developed an object recognition system that integrates visuomotor processes and foveation to achieve reliable recognition. Training is done in interaction with the teacher.



Active object recognition



Training the classifier

Active 3-D vision

3-D vision is not necessary to follow the object with foveal cameras. Only 2-D information and simplified kinematics are used for this purpose.



Grasping can benefit from 3-D vision. Here the robot actively follows the object and determines the grasping configuration by continuously updating the relevant coordinate transformations.



Snapshot extraction

- Integration of vision and motor control
- Bayesian approach for snapshot acquisition: the position and extent of the object can be estimated by minimizing the log-likelihood (using EM-algorithm)
- No prior knowledge about objects necessary

