机器人视觉建模

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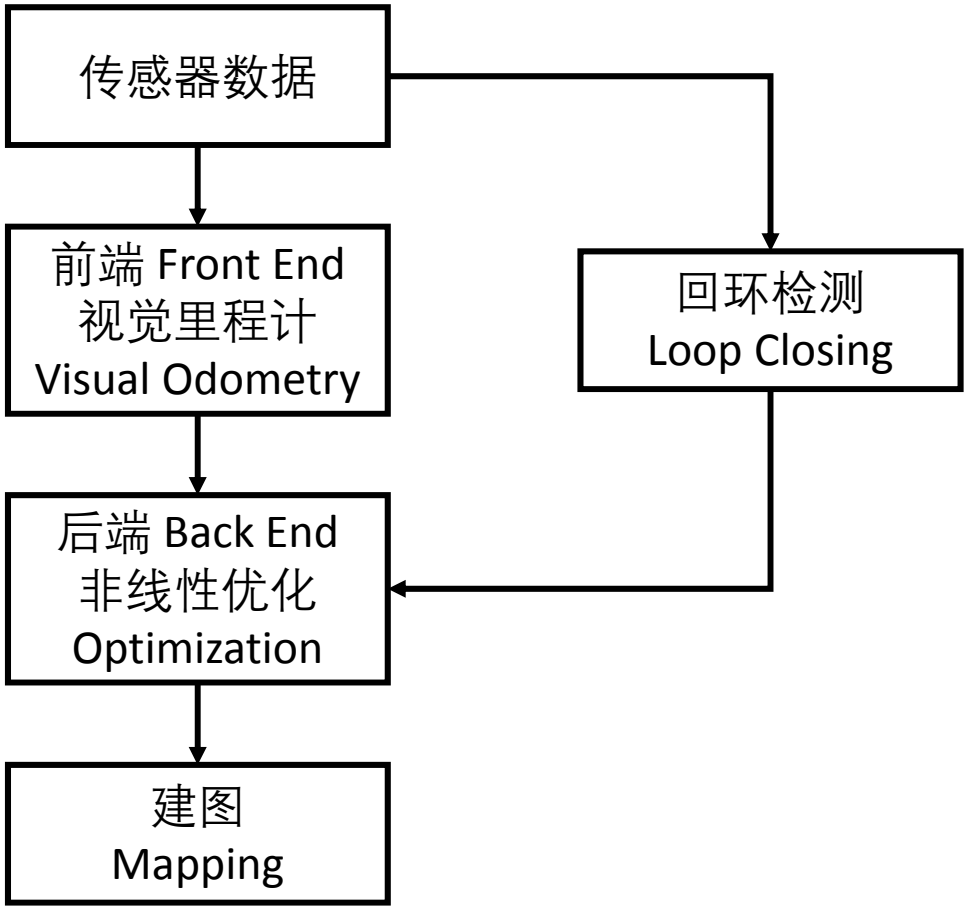
经典视觉SLAM框架

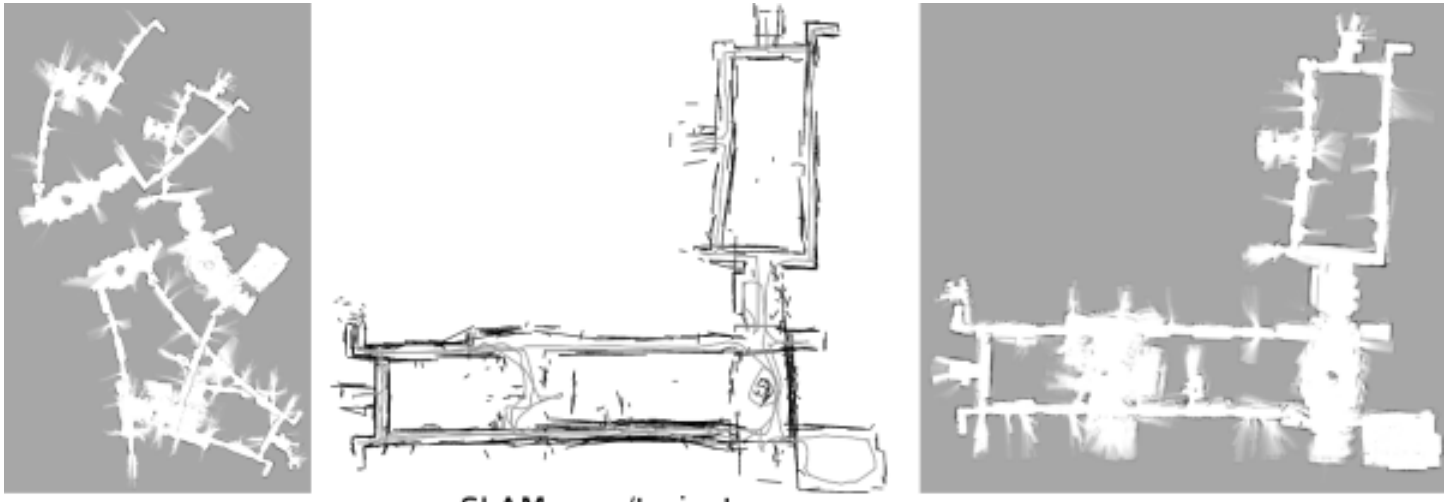

传感器数据
前端 Front End
视觉里程计
Visual Odometry
回环检测
Loop Closing
后端 Back End
非线性优化
Optimization
建图
Mapping

建图 Mapping

- 建图指构建地图的过程
- 地图是对环境的描述
  - 度量地图 Metric Map
  - 拓扑地图 Topological Map

度量地图 Metric Map

- 度量地图强调地图中物体的位置关系
  - 稀疏地图 - Landmark
  - 稠密地图
    - 二维 Grid
    - 三维 Voxel



度量地图 Metric Map

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  - 稀疏地图 - Landmark
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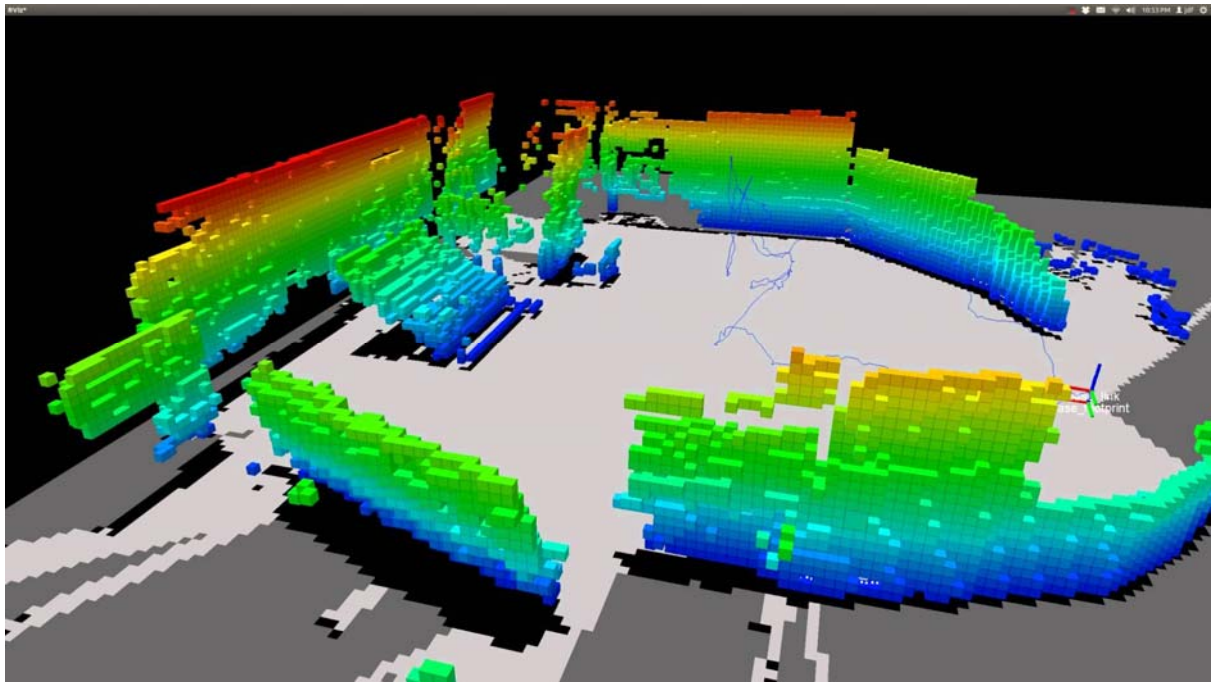
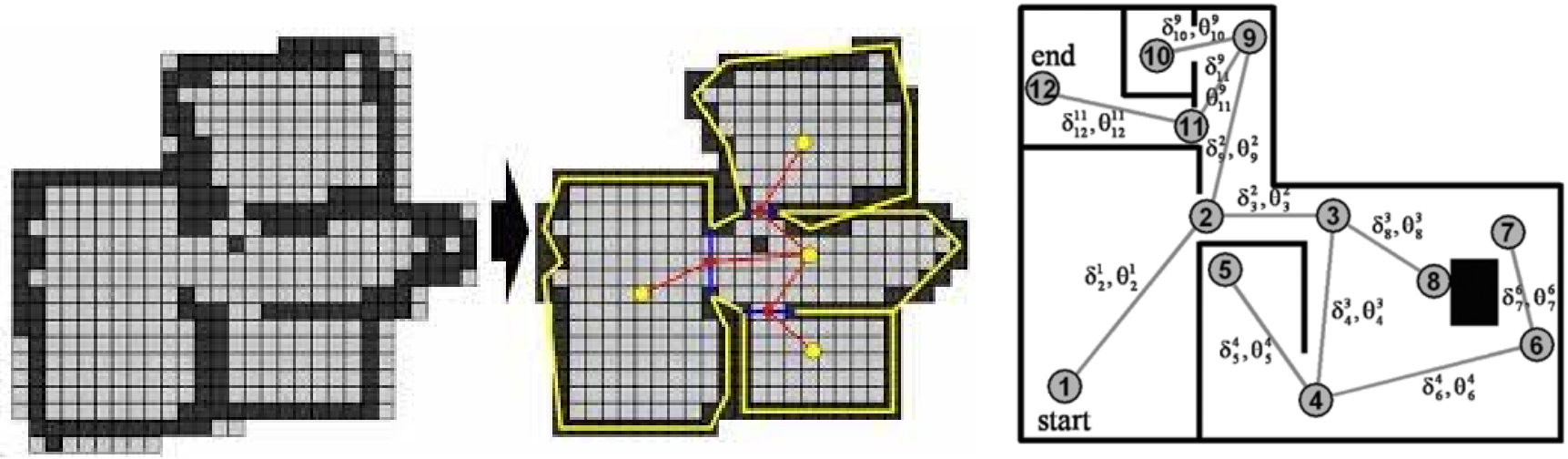


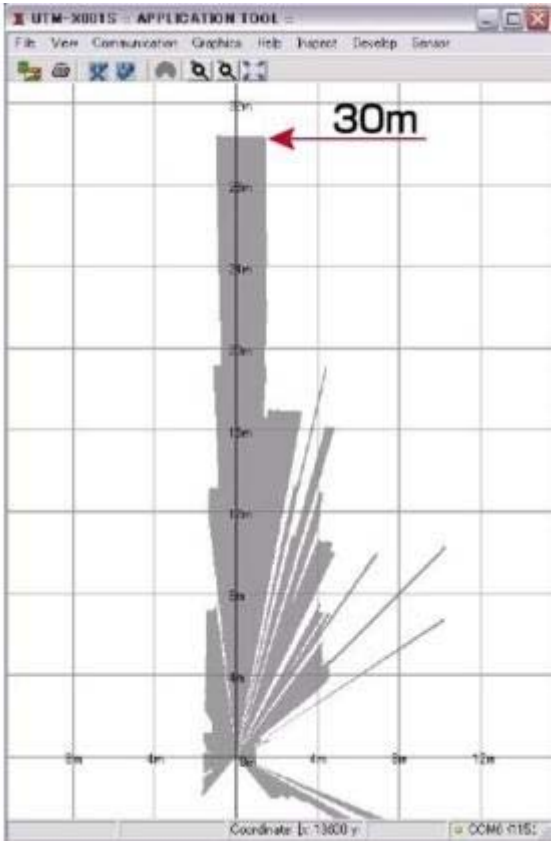

PHANTOM

拓扑地图 Topological Map

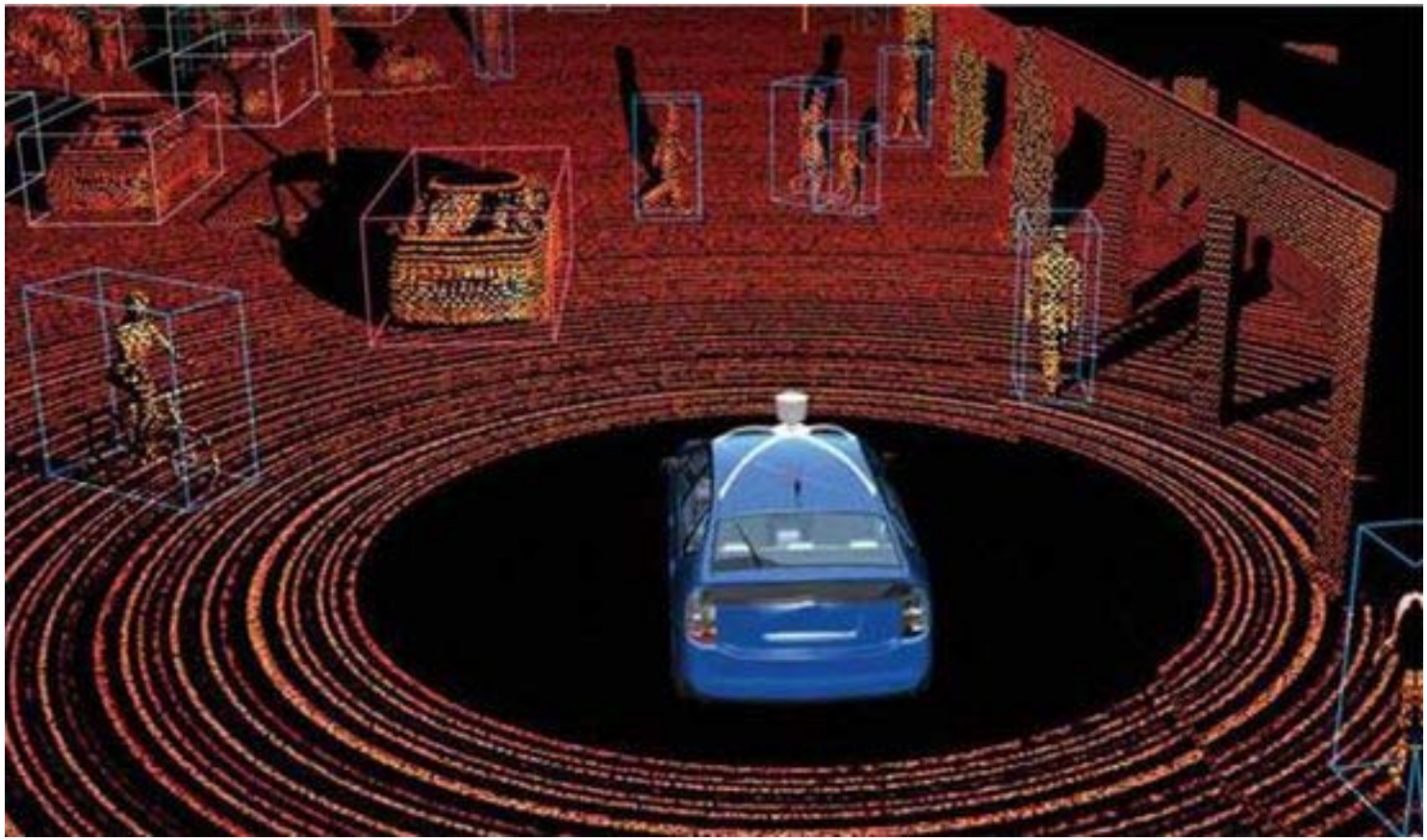
- 拓扑地图强调地图元素之间的关联性
- 主要用于路径规划



二维激光雷达



三维激光雷达



单目相机

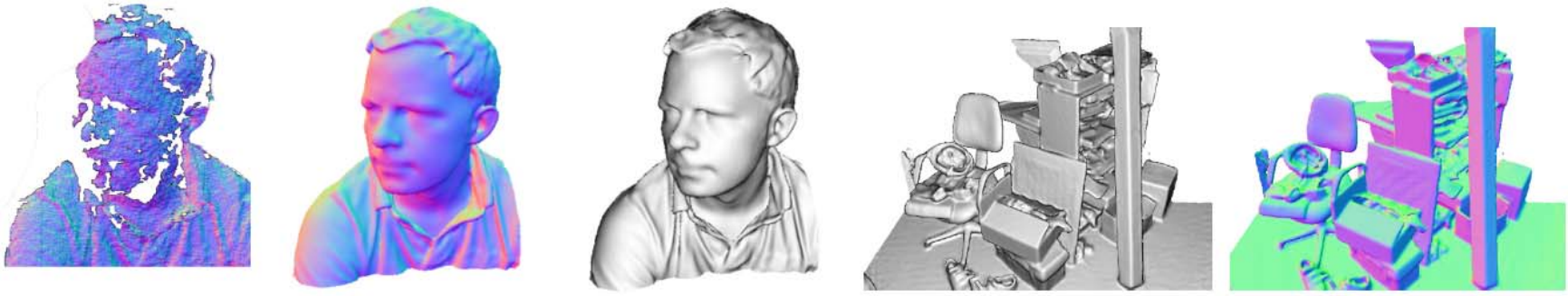
双目相机

RGBD相机


Depth Sensor
(IR Projector + IR Camera)
Color Camera
KINECT
Microphone Array

本节课讨论的两种方法

- R.A. Newcombe, S. Izadi, O. Hilliges et al. KinectFusion: Real-time dense surface mapping and tracking. ISMAR, 2011, pp. 127-136.



本节课讨论的两种方法

- M. Nießner, M. Zollhöfer, S. Izadi, et al. Real-time 3D reconstruction at scale using voxel hashing. ACM Transactions on Graphics, 2013, Vol. 32, No.6, pp. 169.

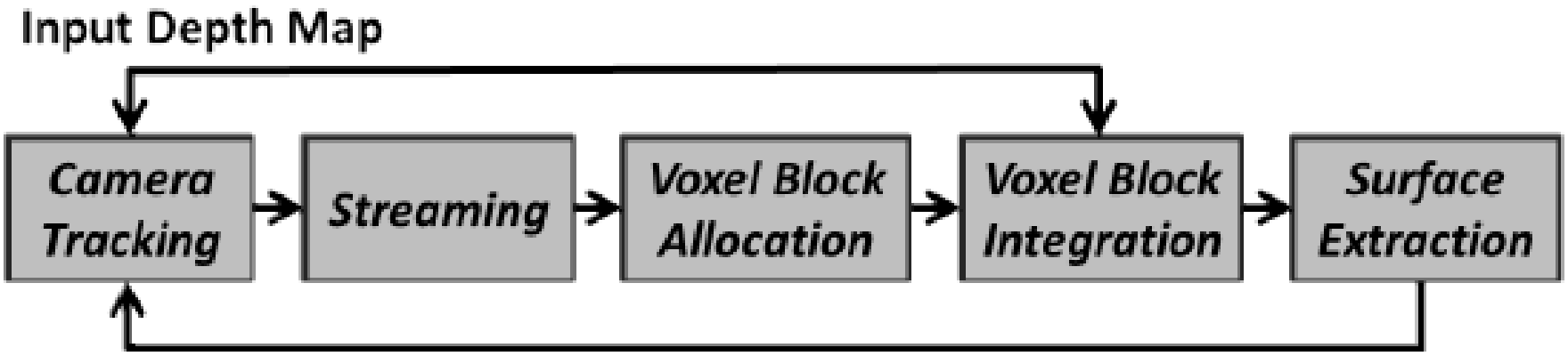
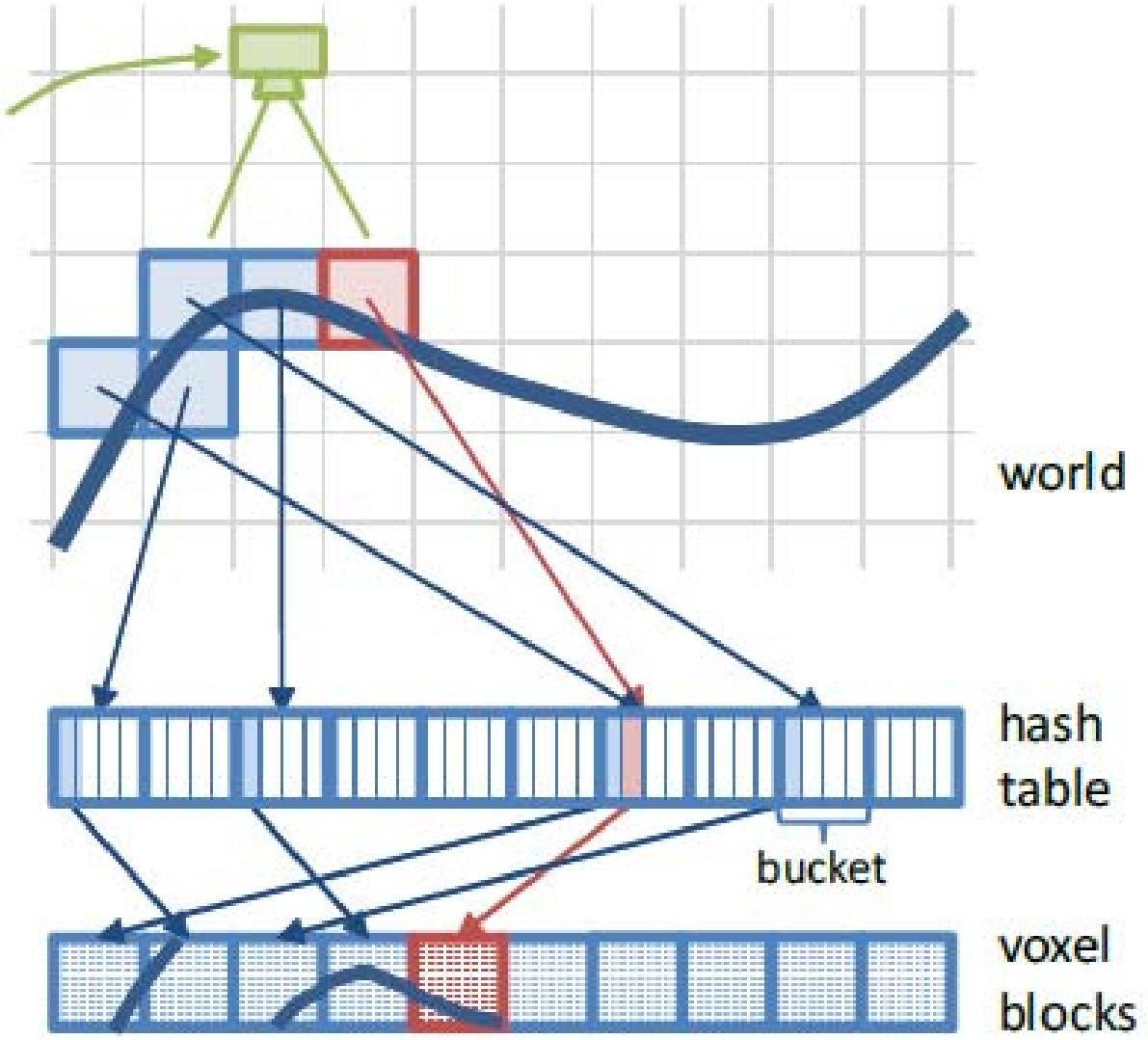


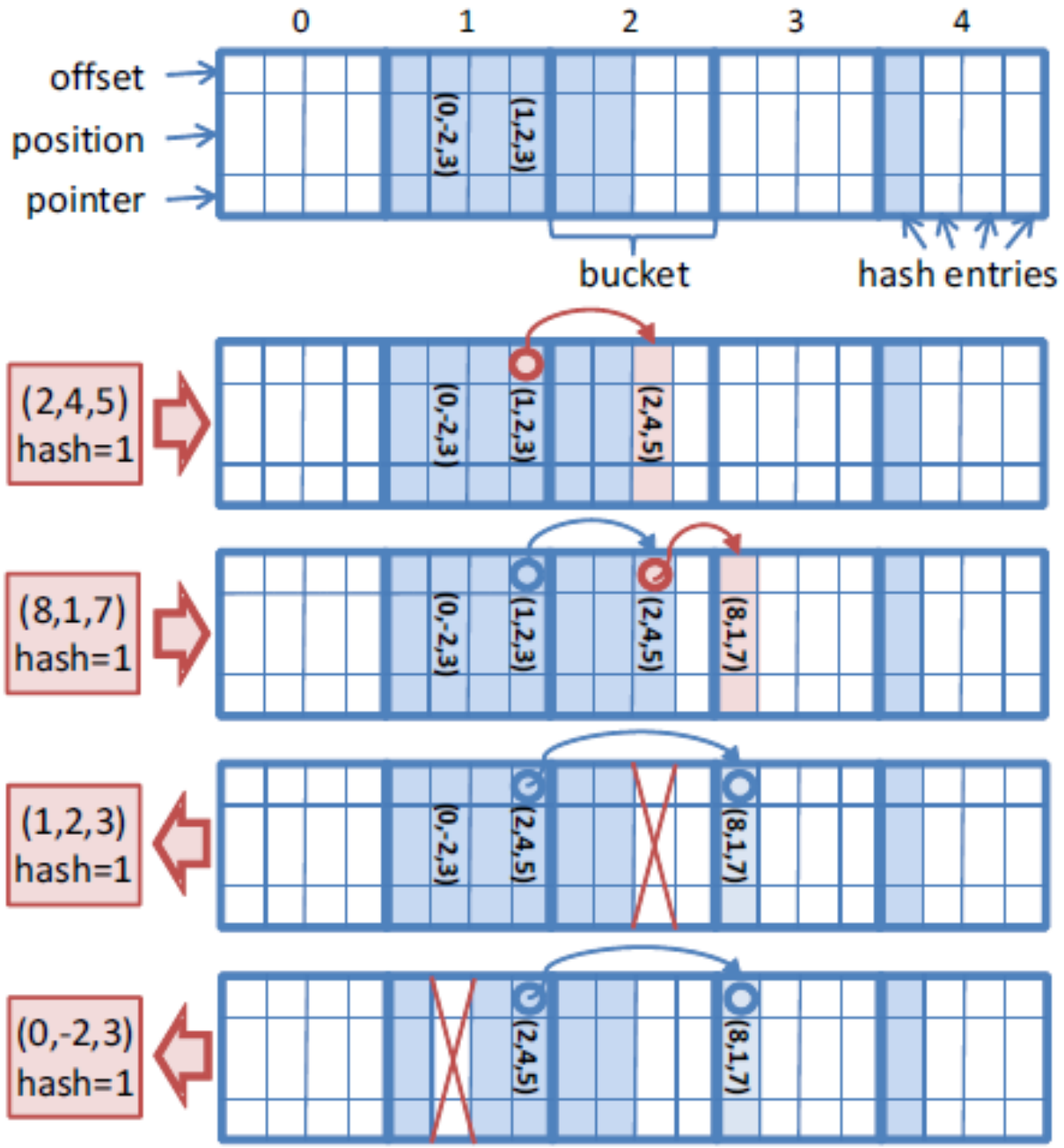
Figure 2: *Pipeline overview.*

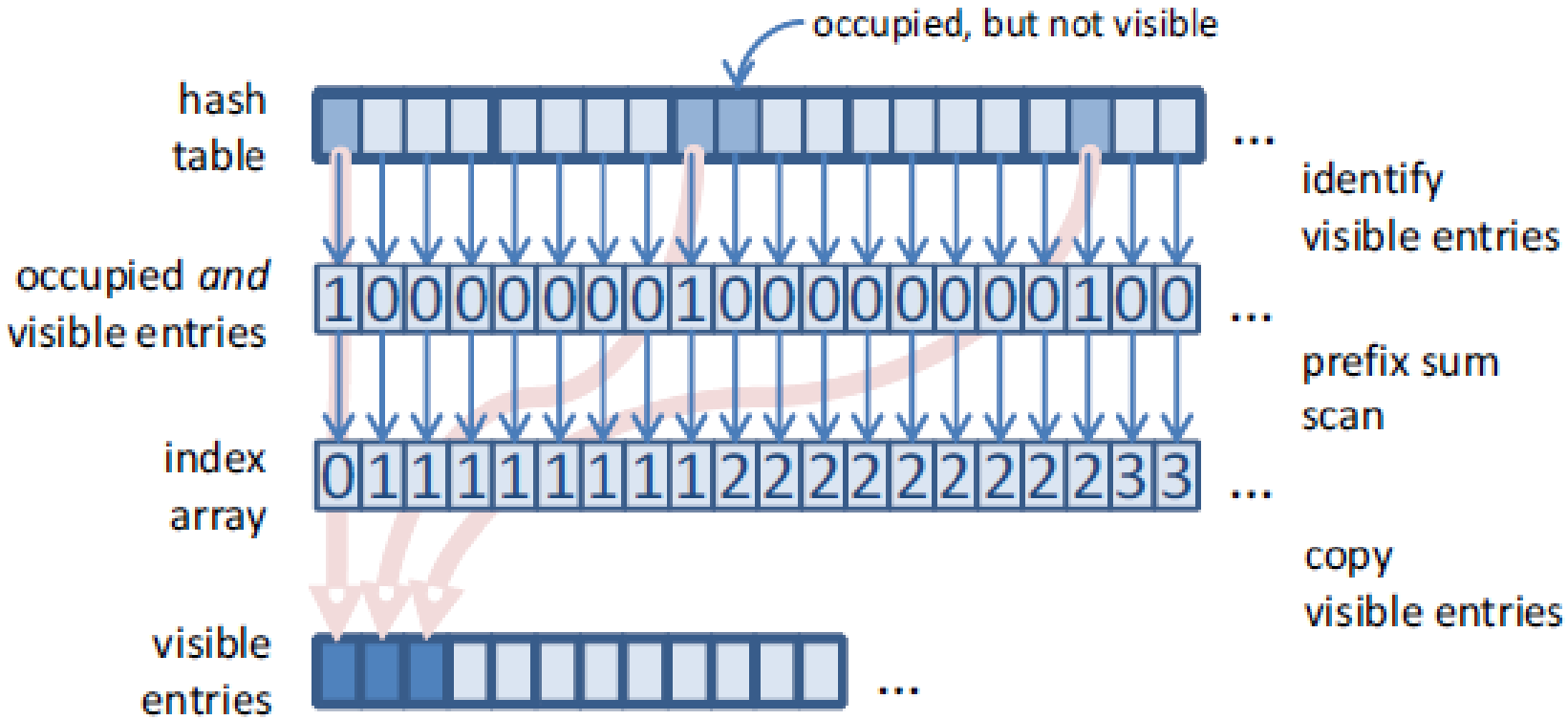
```
struct HashEntry {
   short position[3];
   short offset;
   int   pointer;
};
```

```
struct Voxel {
   float sdf;
   uchar colorRGB[3];
   uchar weight;
};
```

$$H(x, y, z) = (x \cdot p_1 \oplus y \cdot p_2 \oplus z \cdot p_3) \bmod n$$




0
1
2
3
4
offset
position
pointer
(0,-2,3)
(1,2,3)
bucket
hash entries
(2,4,5)
hash=1
(8,1,7)
hash=1
(1,2,3)
hash=1
(0,-2,3)
hash=1


occupied, but not visible
hash table
occupied *and* visible entries
1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0
index array
0 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 3 3
visible entries
identify visible entries
prefix sum scan
copy visible entries