1. Abstract

A reaction-diffusion stereo algorithm consists of multiple systems of reaction-diffusion equations. Since the equations are described with time-evolving partial differential equations, they require much computation time. In addition, the previous reaction-diffusion stereo algorithm does not state any criterion for convergence judgement; we need to compute the equations for enough duration of time until their solutions converge. In this work, for reducing computation time in the reaction-diffusion stereo algorithm, we propose a criterion for convergence judgement and implement the algorithm on a multi-processor computer system.

2. Reaction-Diffusion System

The FitzHugh-Nagumo Reaction-Diffusion Equations

\[
\begin{align*}
\partial_t u &= D_u \nabla^2 u + f(u, v, u_{\text{max}}) + \mu C(x, y, d) \\
\partial_t v &= D_v \nabla^2 v + g(u, v)
\end{align*}
\]

Disparity map:

\[
M(x, y, t) = \arg \max_d u_d(x, y, t)
\]

3. Reaction-Diffusion Stereo Algorithm

Multiple Reaction-Diffusion Systems

\[
\begin{align*}
\partial_t u_d &= D_u \nabla^2 u_d + f(u_d, v_d, u_{\text{max}}) + \mu C(x, y, d) \\
\partial_t v_d &= D_v \nabla^2 v_d + g(u_d, v_d)
\end{align*}
\]

4. Convergence Judgement & Parallel Implementation

- **Criterion for convergence judgement:**
  \[M(x, y, t) = M(x, y, t-\delta t)\]

- **Parallel implementation of multiple reaction-diffusion systems on a multi-processor computer system.**

5. Results

\[\text{Error (\%)}\]

\[\text{Computation Time (hours)}\]

\[\text{Number of CPU Cores, } n\]

\[\text{Disparity Map (M(x,y)=M(x,y,t-\delta t))}\]

\[\text{Type-1: TEDDY, Type-2: CONENS, Type-3: TSUKUBA, Type-4: VENUS}\]

\[\text{Disparity levels: N=60, Error(BMA)=<15\%}\]