

Prioritization and Static Error Compensation for Multi-Camera Collaborative Tracking in Augmented Reality

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Background

World-Anchored Tracking System

the pose of the tracker coordinate system remains unchanged with respect to the world coordinate system

User-Anchored Tracking System

this type of tracking system is attached to the user, and provides a perspective that is closer to that of the user

+ Accuracy - Occlusion

Incorporate

Algorithm

Data: Priority value P_i of all tracking units U_i

Result: Pose T of the target object

begin

Initialize tracking result for all tracking units T_i ; Find the tracking unit with highest priority U_{max} ;

Initialize static transformation error D_i between U_{max} and all other tracking units $U_i, U_i \in \{U\} \setminus U_{max}$;

while running do

if $T_{max} \neq 0$ **then**

$T = T_{max}$;

 Update static transformation error D_i , s.t.

$T_{max} = D_i \cdot T_i$;

else

 Find the available tracking unit with highest priority $U_k, P_k = \max\{P_i\}$, where $T_i \neq 0$;

$T = D_k \cdot T_k$;

end

end

end

Method

Prioritization:

All the tracking units $U_i, i = 1, \dots, n$ are labeled with a priority value P_i based on their tracking performance.

Assumption:

$$T_i(t) = \Delta T_i(t) \cdot T, T_i(t+\Delta t) = \Delta T_i(t+\Delta t) \cdot T$$

$$T_j(t) = \Delta T_j(t) \cdot T, T_j(t+\Delta t) = \Delta T_j(t+\Delta t) \cdot T$$

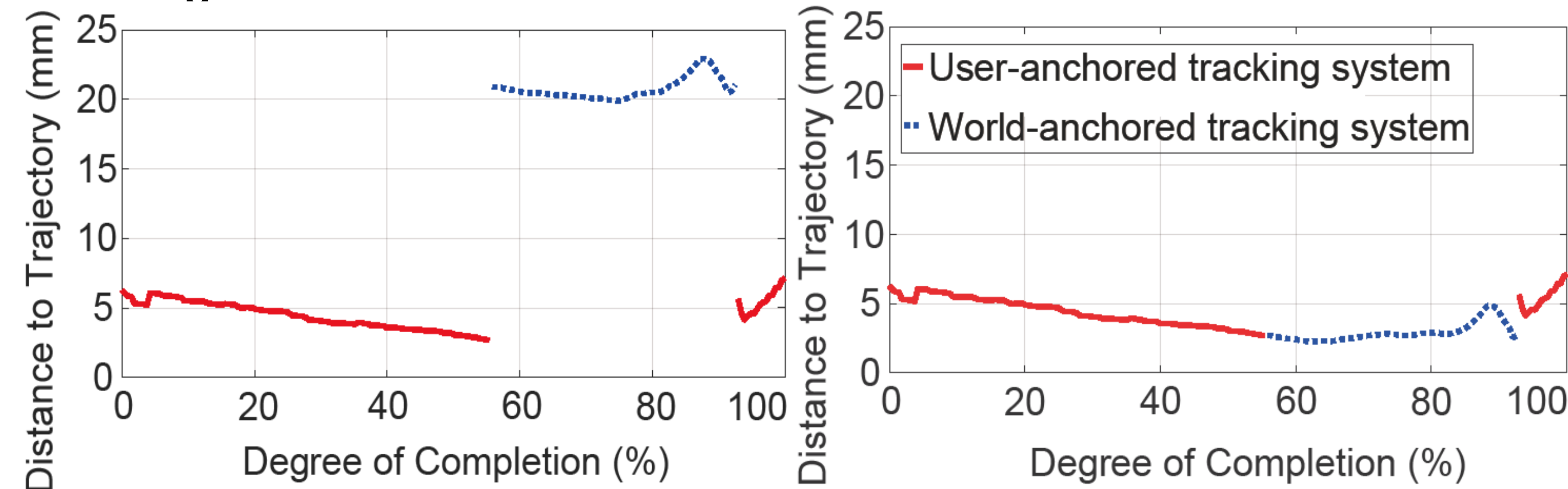
$$D_{ij}(t) = T_j(t)^{-1} \cdot T_i(t) = \Delta T_j(t)^{-1} \cdot \Delta T_i(t)$$

$$D_{ij}(t+\Delta t) = T_j(t+\Delta t)^{-1} \cdot T_i(t+\Delta t) = \Delta T_j(t+\Delta t)^{-1} \cdot \Delta T_i(t+\Delta t)$$

$$\Delta T_i(t) \cong \Delta T_i(t+\Delta t), \Delta T_j(t) \cong \Delta T_j(t+\Delta t)$$

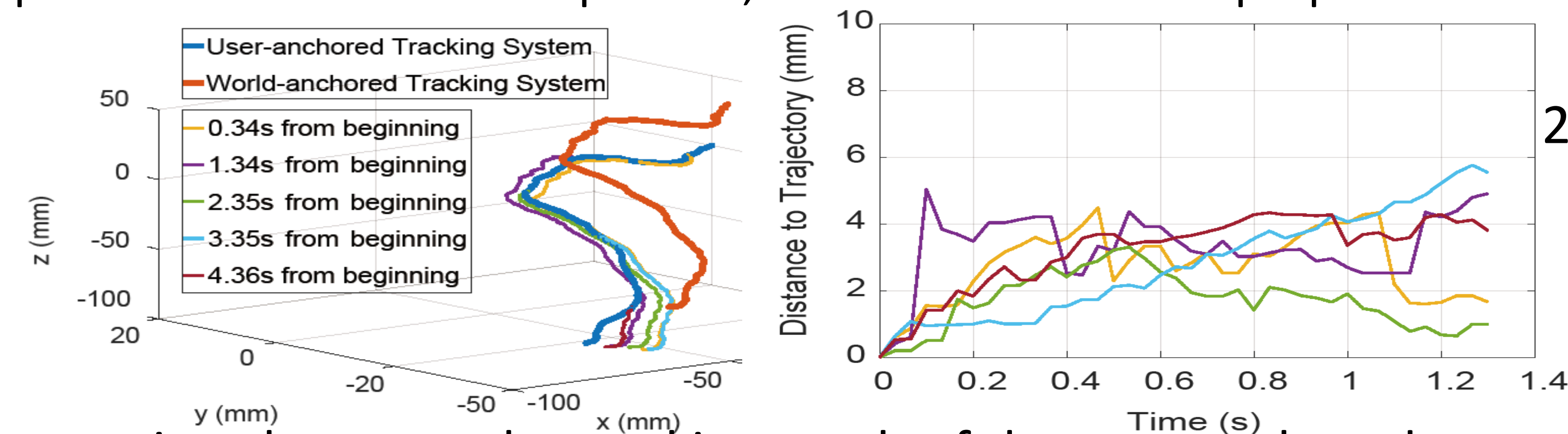
$$D_{ij}(t) \cong D_{ij}(t+\Delta t)$$

Algorithm 1: Prioritization and static error compensation for multi-camera collaborative tracking



1. Switching from the user-anchored camera to the world-anchored camera becomes smoother, and the augmented reality experience for the user is thus improved

Experimental result of a sample trial, with and without the proposed method: prioritization and static error compensation



2. The error is significantly reduced when compared to the direct application of the tracking result from the low-priority camera.

Comparison between the tracking result of the user-anchored camera and the world-anchored camera with the proposed method applied at different time periods

Result

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Logitech Pro c920 and c9000 for world-anchored cameras
Meta One for user-anchored camera
ARToolKit for marker tracking