Measuring straight time in elite short track speed skating relays

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Measuring straight time in elite short track speed skating relays

Andrew Hext, Ben Heller, John Kelley and Simon Goodwill

Overview

- Background
- Introduction
- Method
- Results
- Discussion
- Practical implications

Background

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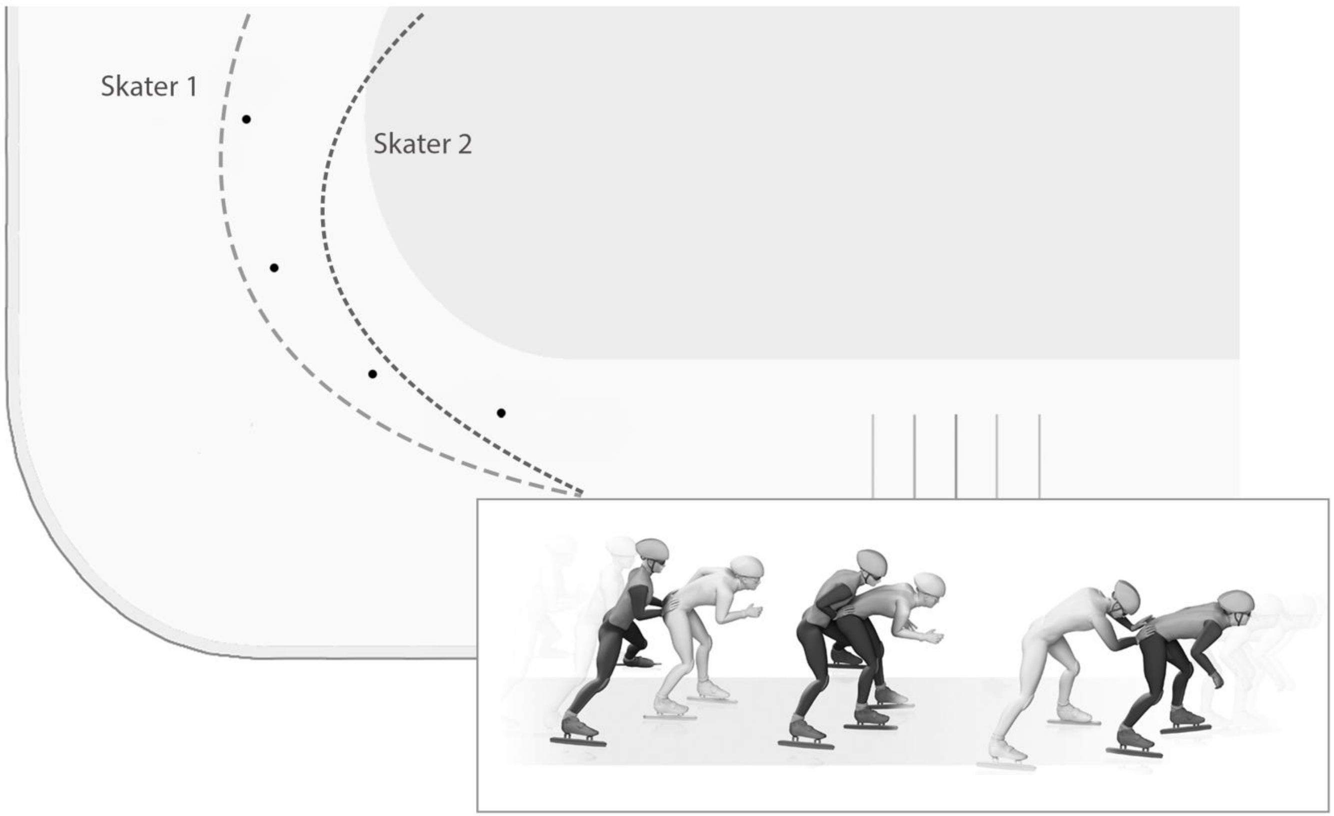
Background

- Advancement through the competition, and medal colour, is dependent on finishing position not finishing time.
- Strategy and tactics play an important role for success in short track speed skating.

Introduction

- 3000 m (27 laps) and 5000 m (45 laps).
- Races involve 3-6 teams, consisting of 4 skaters each.
- Additional strategic component to races: the relay exchange.
- Allows a team to change the skater involved in the pack race.

Introduction



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Introduction

- Typically executed every 1 ½ laps (17 and 29 exchanges).
- Time can be gained or lost during this period of the race due to the execution of the relay exchange.
- Only temporal measurement reported is lap time, of which the relay exchange accounts for less than 30 %.

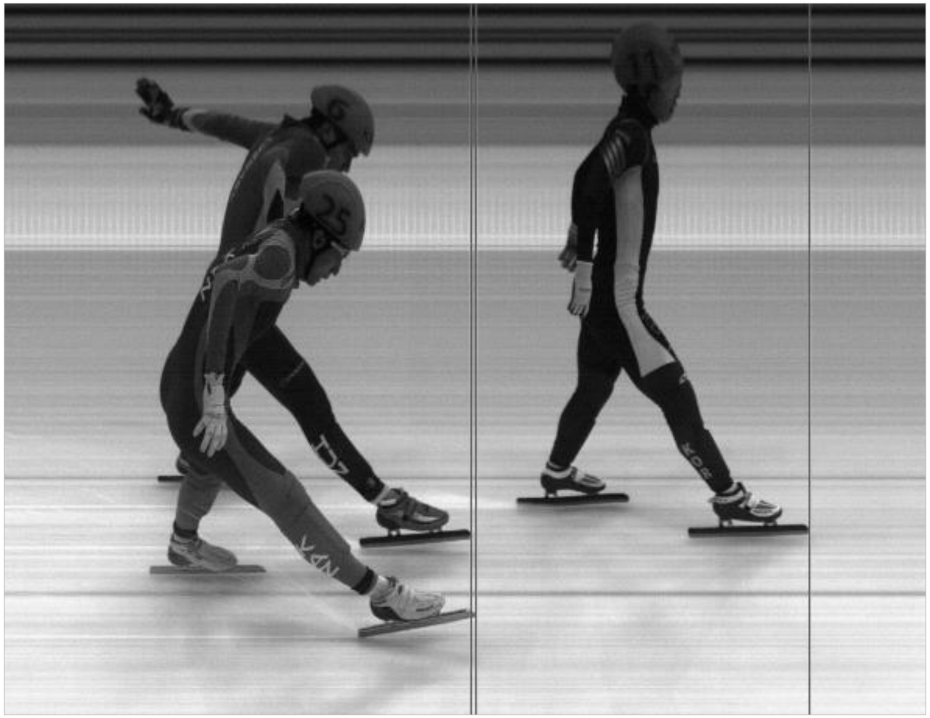
Introduction

Aim: To validate a method for measuring a more appropriate temporal measurement of relay exchange performance.

Introduction

- The time taken to complete the straight where the relay exchange was executed.

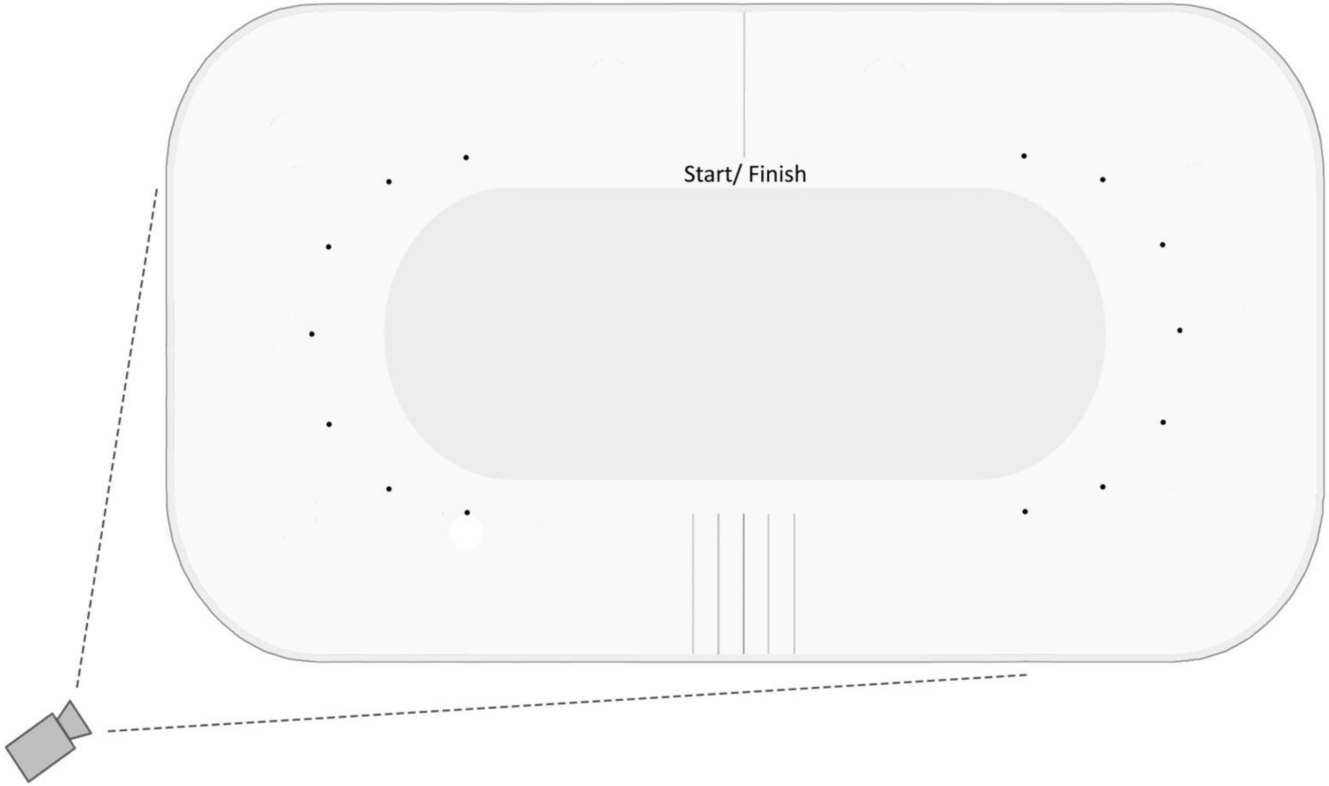
Method



- High speed video provides highest temporal resolution.
- Not viable in competition environment.

Method

- Method uses a single HD camcorder (50 Hz, progressive scan).



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Method

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Method

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Method

Method

Straight $_{Start}$ Frame

Straight $_{End}$ Frame

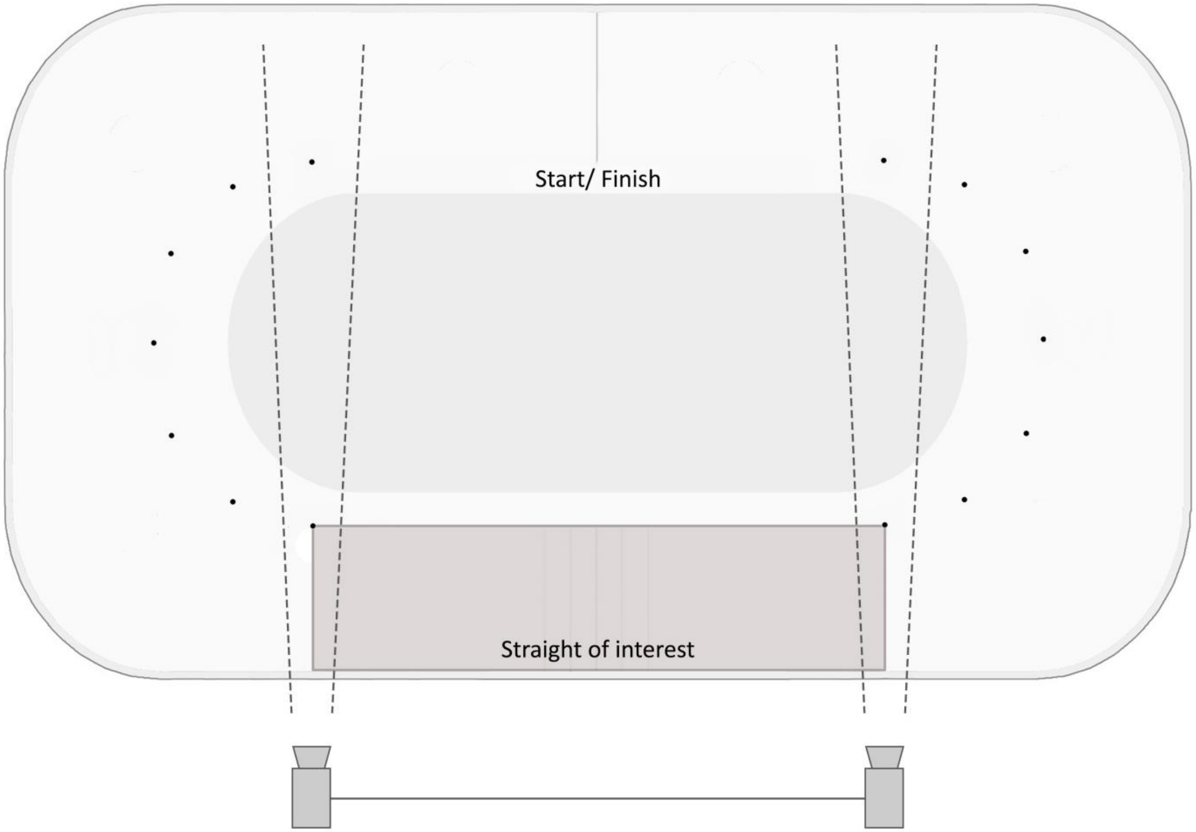
- Straight time calculated using the frame number difference between start and end frames, at a resolution of 0.02 seconds.

Method

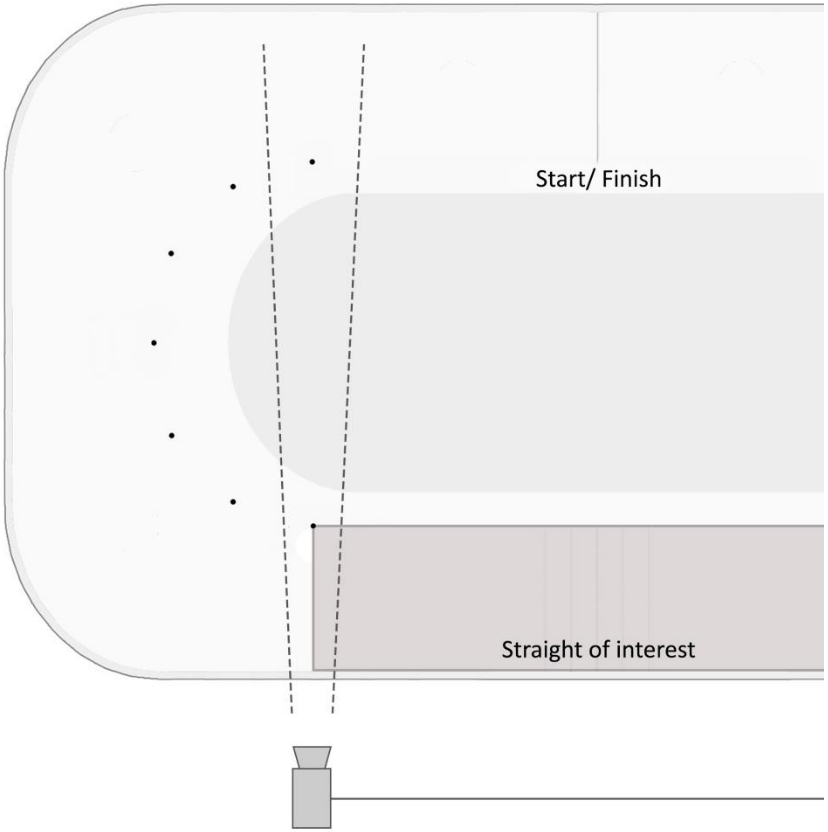
Validation Procedure:

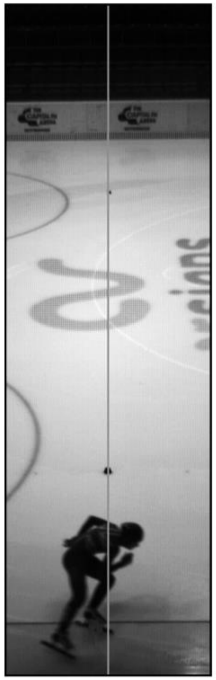
- Captured a 5000 m relay race at the National Performance Centre for Short Track Speed Skating, Nottingham, UK.
- Eight skaters (two relay teams).
- All participants were members of the Great Britain short track speed skating performance programme.

Method



Method





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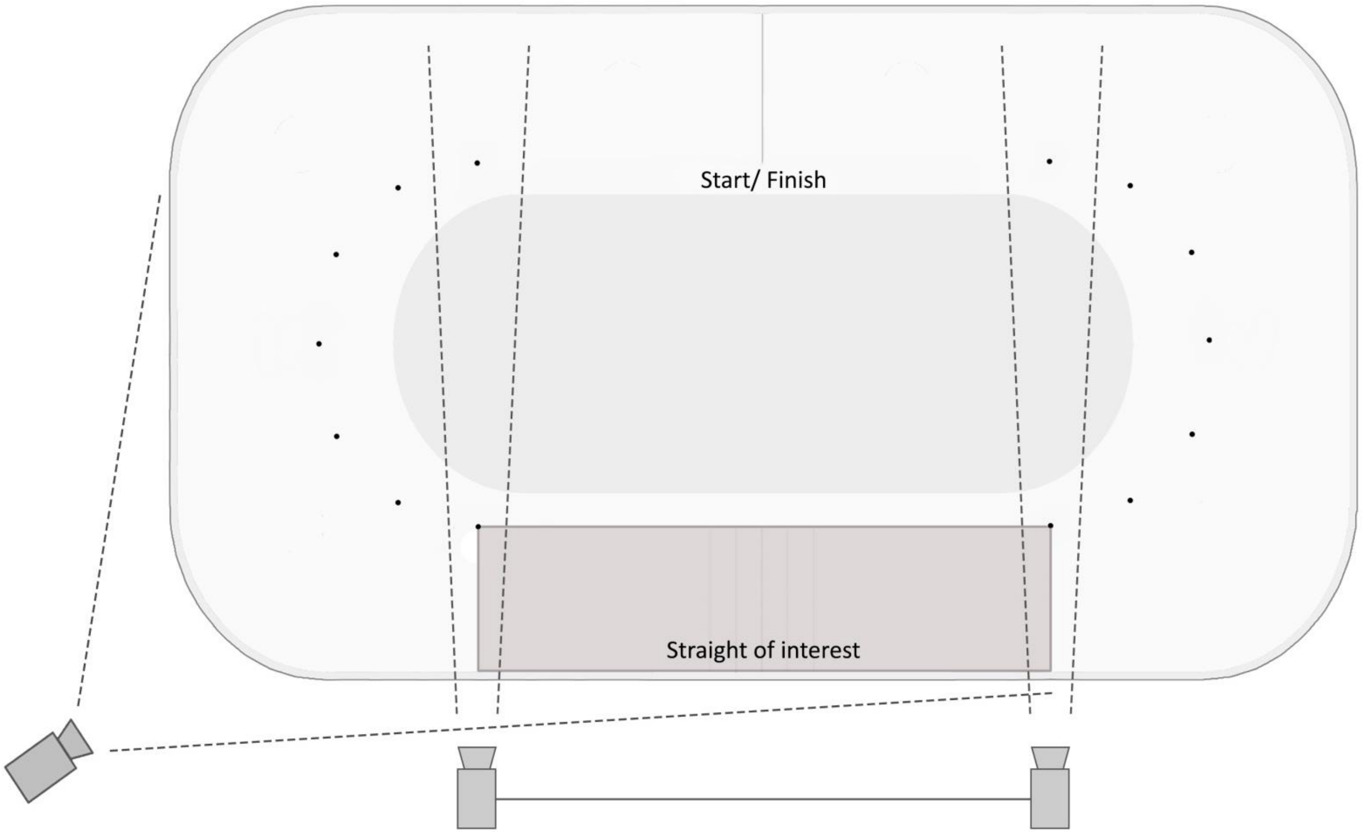
Method



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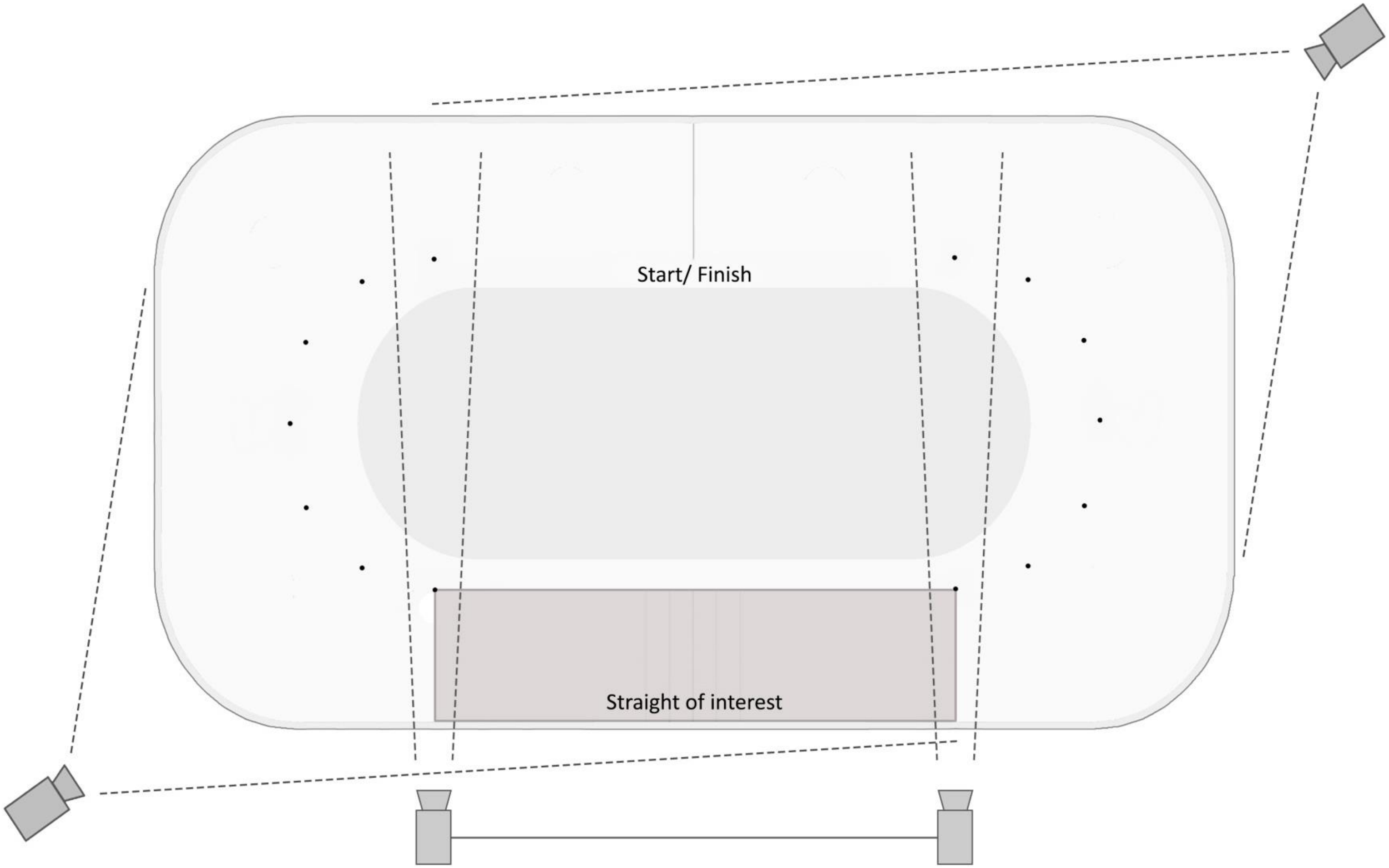
Method



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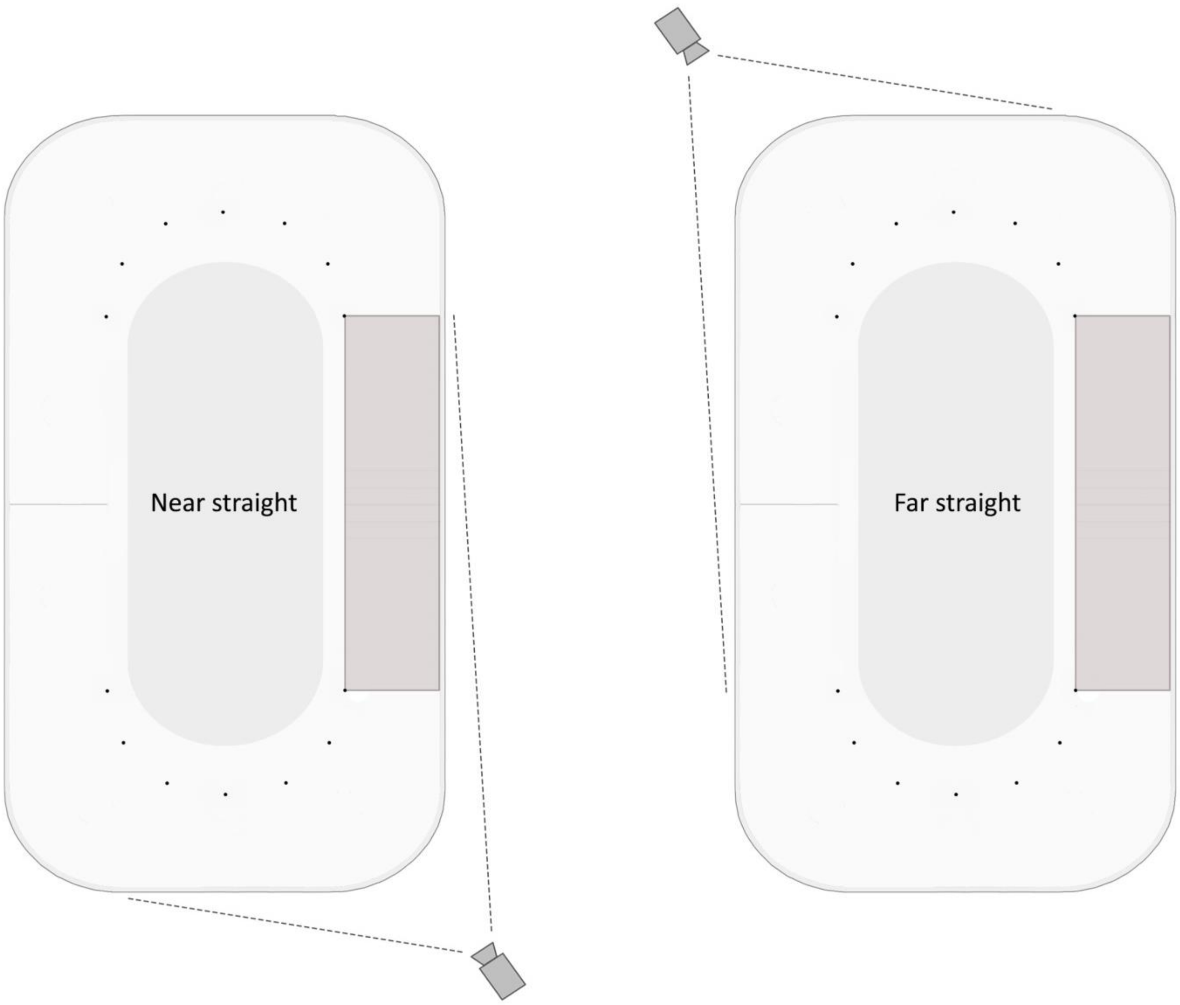
Method



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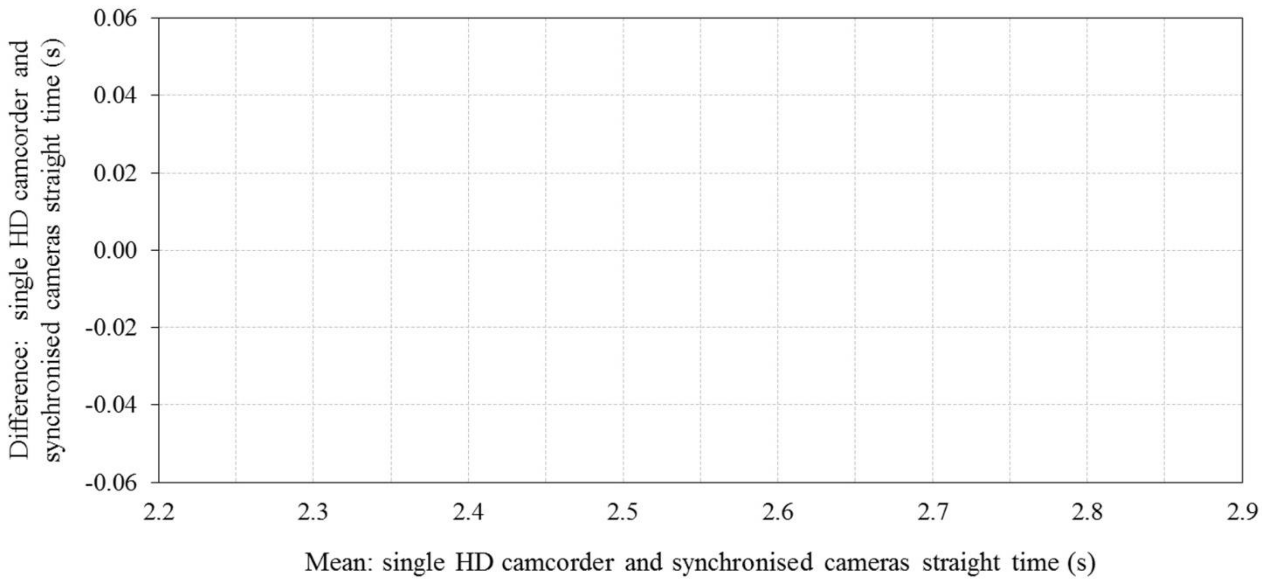
Method

Statistical analysis:

- Root mean square error was used to measure the differences in straight time between the synchronised cameras and single HD camcorders.
- Agreement was measured between the two methods using Bland and Altman's 95 % limits of agreement.

Method

Bland & Altman 95 % limits of agreement:



- Allows fixed and proportional bias to be assessed.
- If 95 confidence intervals include 0, infers that no bias present.

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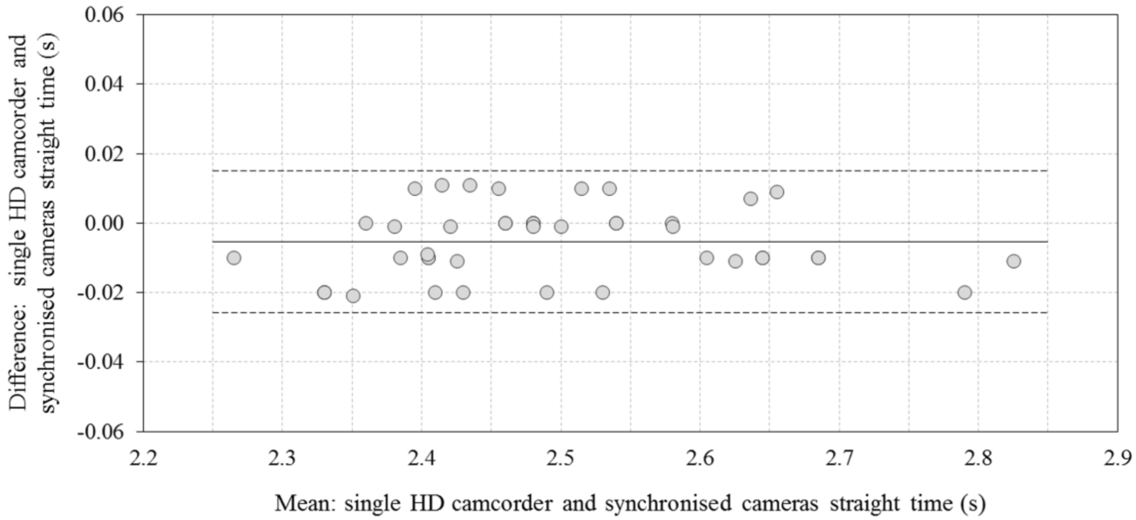
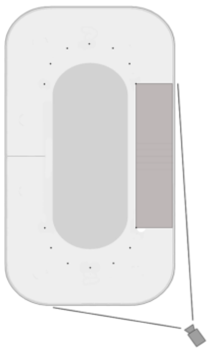
Results

Results

Near Straight:

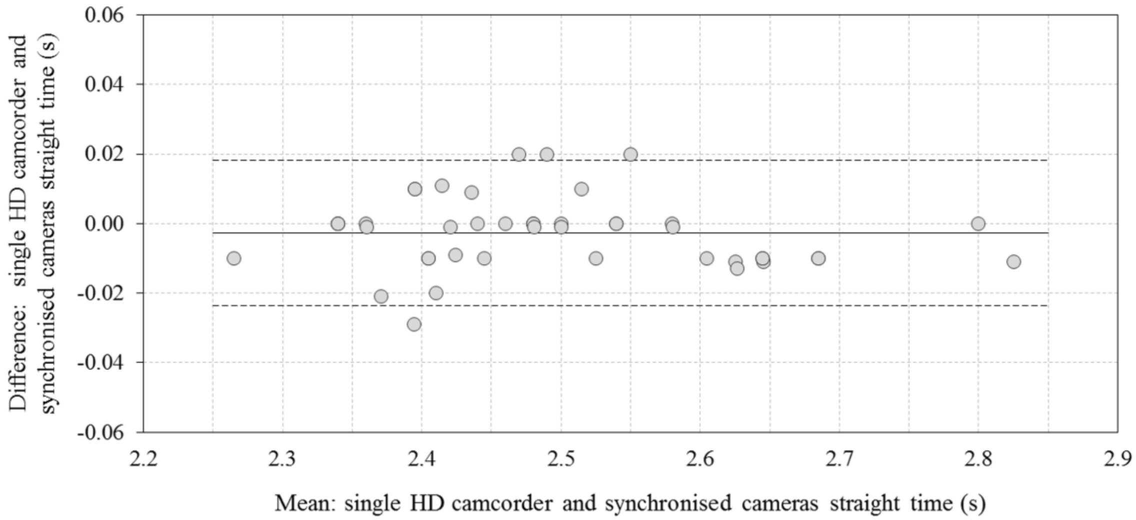


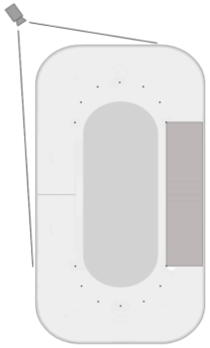


- 0.011 second root mean square error.
- -0.0054 seconds, 95 % CI [-0.0085, -0.0024] mean difference.
- -0.021 seconds, 95 % CI [-0.0851, 0.0430] intercept.

Results

Far straight:





- 0.011 second root mean square error.
- -0.0027 seconds, 95 % CI [-0.0059, 0.0004] mean difference.
- -0.018 seconds, 95 % CI [-0.0473, 0.0842] intercept.

Discussion

- RMSE less than 0.02 second temporal resolution of camera.
- Single HD camcorder invariant to race speed.
- Small fixed bias was found for the near straight:
  - ~ 25 % of the 0.02 second temporal resolution.
  - 0.2 % of the overall mean straight time.
  - Magnitude of fixed bias minimal.
  - Occlusion at the end of the near straight.

Discussion

- Occlusion is a problem for all image based measurement systems.
- Study did not fully recreate occlusion of a typical relay race.
- Results based on a single camera view point.
- The validity of the method may be sensitive to changes in camera position.

Practical implications

- A single HD camcorder can be used to measure straight time.
- A more specific temporal measurement can now be used to assess whether the execution of the relay exchange allows time to be gained or lost.
- Method could be developed to measure corner entry and exit time.

Any questions?

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