Baseball 4D: A Tool for Baseball Game Reconstruction & Visualization
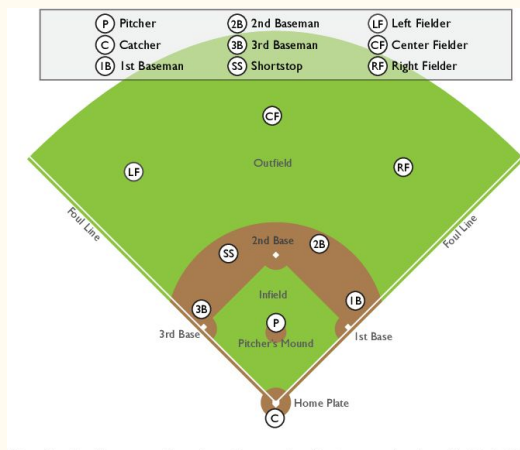
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Reference Link:

https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7042478

What is it?

Fig. 2 - A diagram showing the various features of a baseball field.

- Visual analytics tool for baseball games to enable analysis of high-resolution, time varying player and ball 3D tracking data streams.
- Technique has been used on over **1,100 games** comprised of over **52,000 play segments.**

Goals

Fig. 2 : A diagram showing the various features of a baseball field.
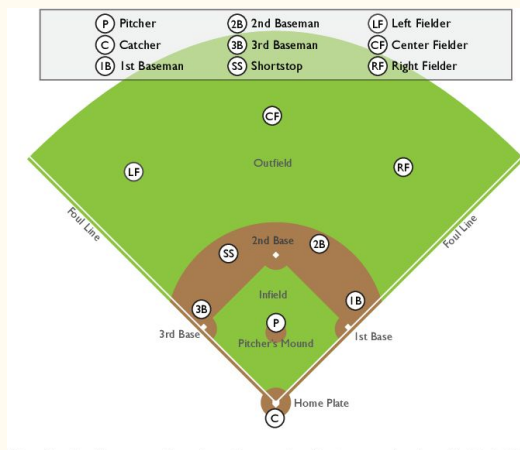
- Go beyond outcome-based statistics (i.e. batting average) so that the entirety of the play, and multiple plays, can be taken into account (i.e. reaction time, speed).
- Follow Shneiderman's visual information mantra: **"overview first, zoom and filter, then details on-demand"**.

Data Architecture

Processing the data streams

- Obtained from different hardware.
- Needs to be aligned based on timestamps.
- Four types of filtering:
  - **Positional:** Do not jump around the field.
  - **Timing:** Even sampling.
  - **Event:** Game events match rules.
  - **Semantic:** Snapshots match player, pitch, and game information (i.e. catch cannot occur unless player and ball are in close proximity).
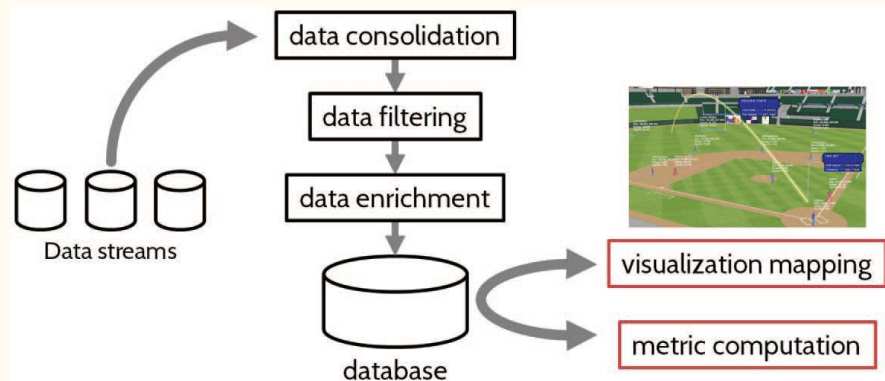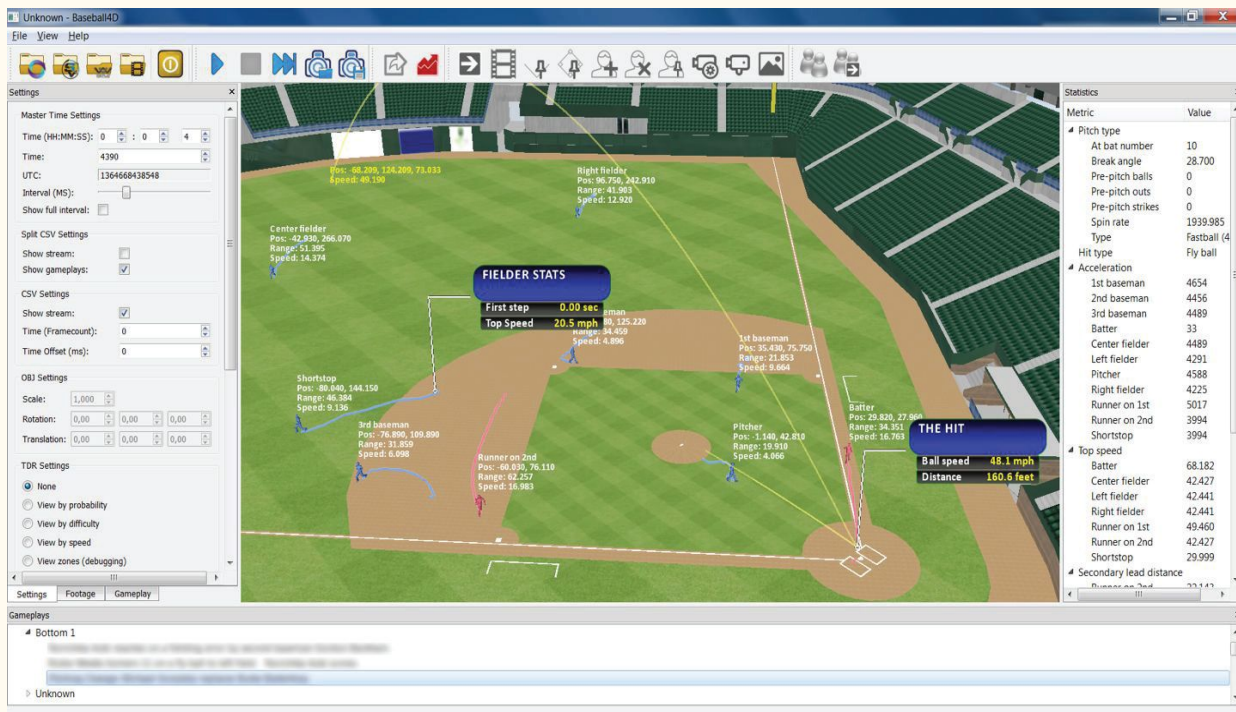
Data integration for gameplay reconstruction

- Gameplays are defined between game events and combine all available records in that time range.
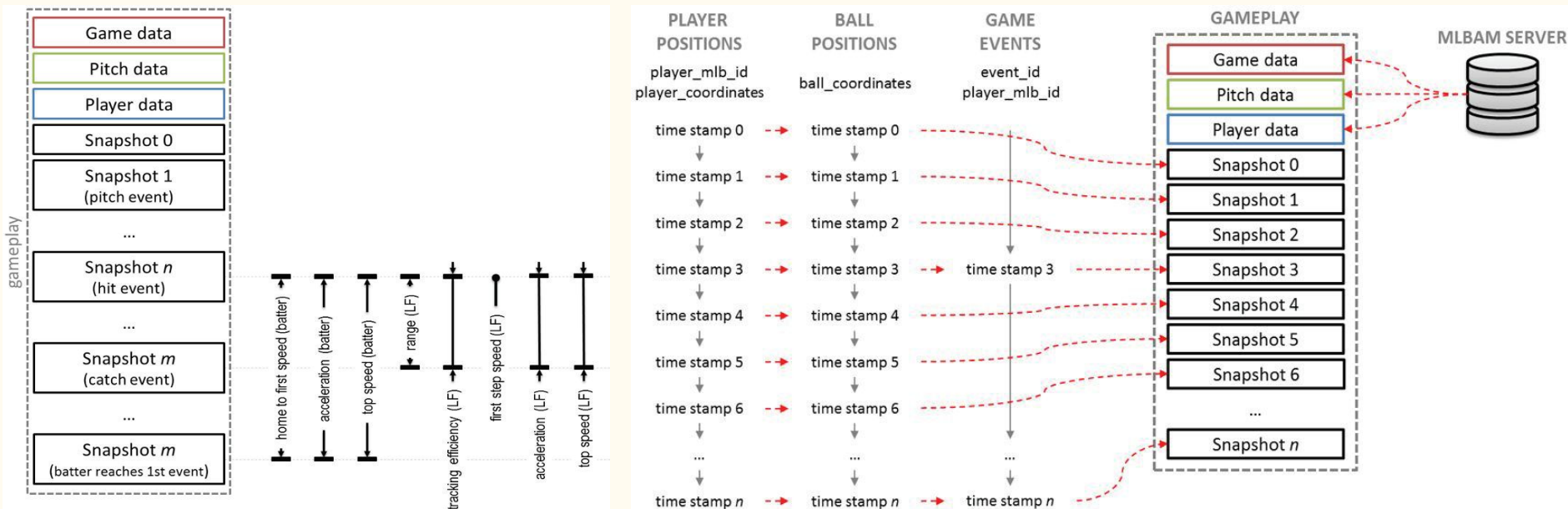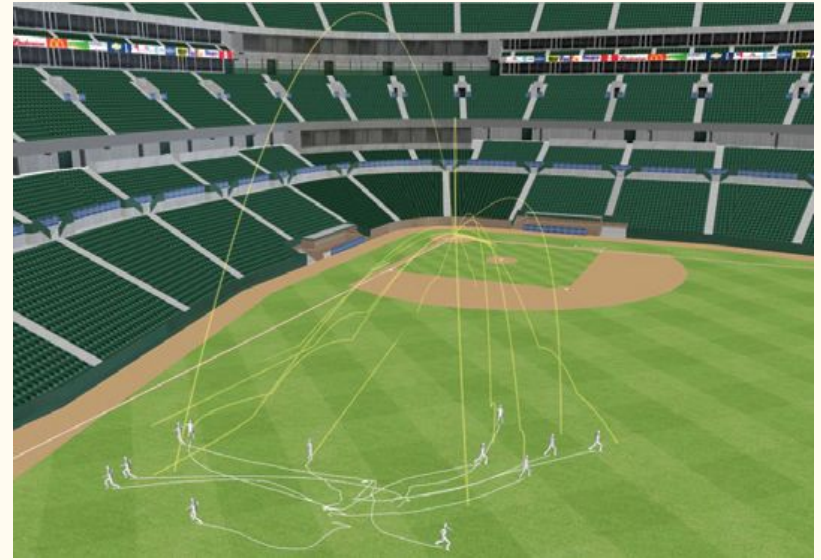
Tools and Visualizations

Visual components for play timeline

- Interactive views for one or more plays.
- Filtering and selecting related statistics and metrics (static and dynamic).
- Gameplays on-demand.

- Visual elements highlight player and ball tracks.
- Examine fielders position in a game for a specific batter or a particular fielder's movement during a game.

# Locations of all hit balls and player positioning at pitch release
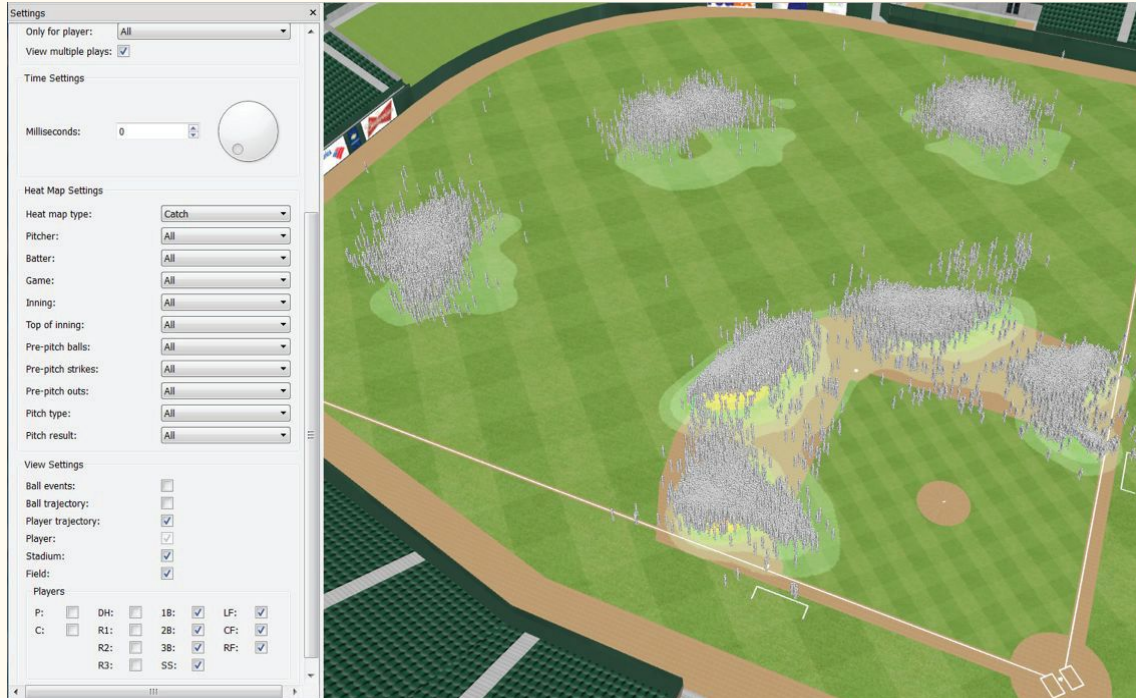
- Aggregate of plays.
- Allows analysts to see how teams or specific players are positioned during a game.
- **Example:** suggests 3rd baseman and shortstop field most of the hits, perhaps higher number of right-handed at bats.
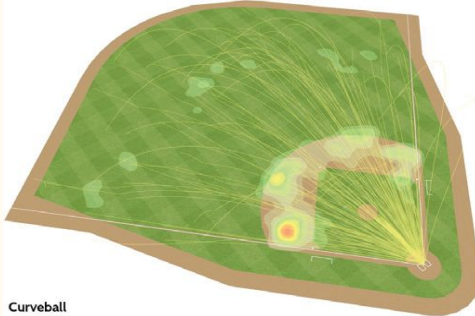
Understanding hit ball trajectories and player movements for different pitch types
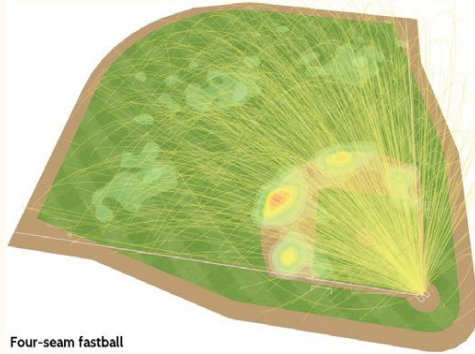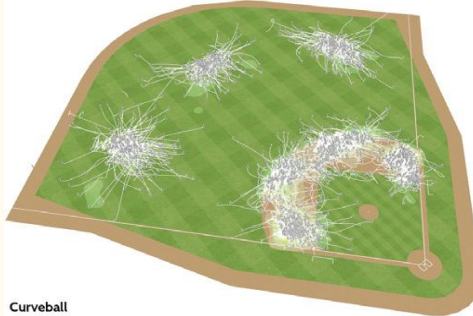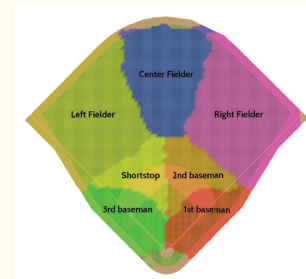

Four-seam fastball
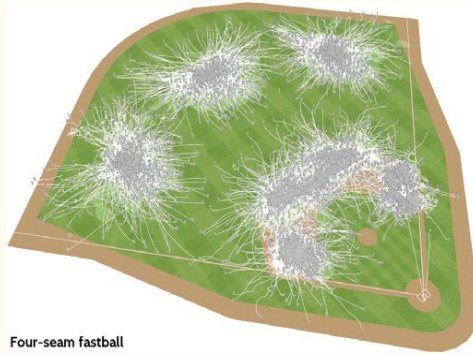
Four-seam fastball

Curveball

Curveball

- Can be filtered by pitcher and batter name, game, inning, # balls and strikes, etc.
- **Use case:** manager signals a particular pitch to induce a double play.

Analyzing defensive play difficulty

Motivation: Generally the number of errors is the only measure available to compare fielding performance.
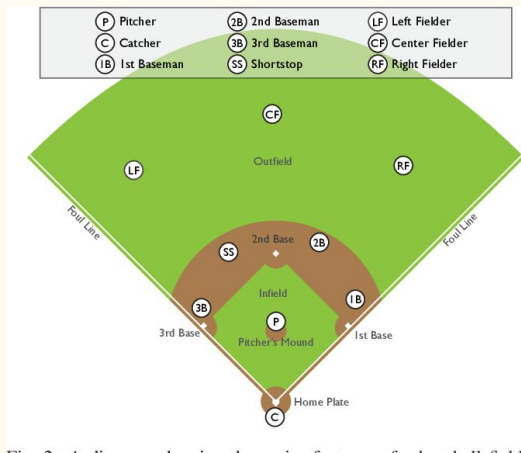
1. Fielder's running speed (i.e. at least 10.2 mph).

2. True Defensive Range (TDR). Probability that a hit will be fielded.

For example: Instead of saying if the player was able to catch the ball or not, use the time the ball was in the air and the distance from the fielder's initial position.

▲ hard catch
● easy catch

hard
▲ 10%
● 25%
■ 50%
75%
✕ 90%
Y above 90%
easy
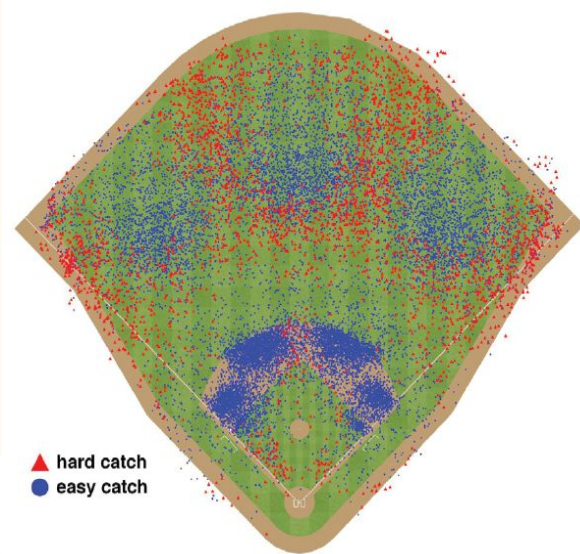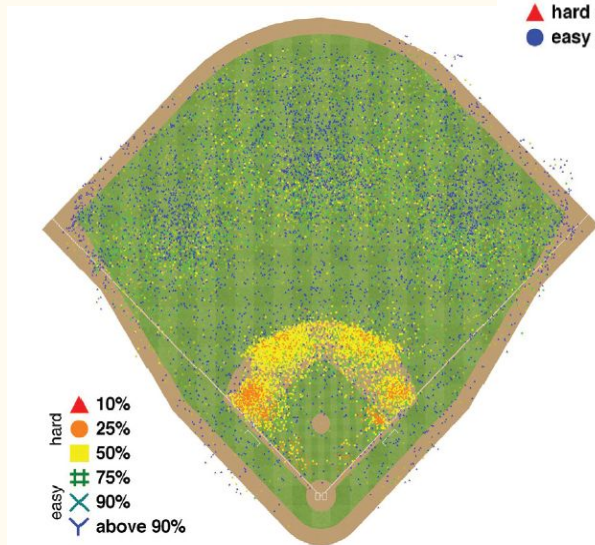
To Summarize

1. Single gameplay, showing how visual elements augment the exploration of a reconstructed play.
2. Query capabilities over information from multiple gameplays to generate insight into specific game situations.
3. Analyze True Defensive Range (TDR) metric (spatiotemporal metric about defensive skill).

Q&A

References

IEEE Site Link

https://ieeexplore.ieee.org/Xplore/home.jsp

Presentation Paper Direct Link

https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7042478