

## Improved vertical ground reaction force estimation using signal section filtering



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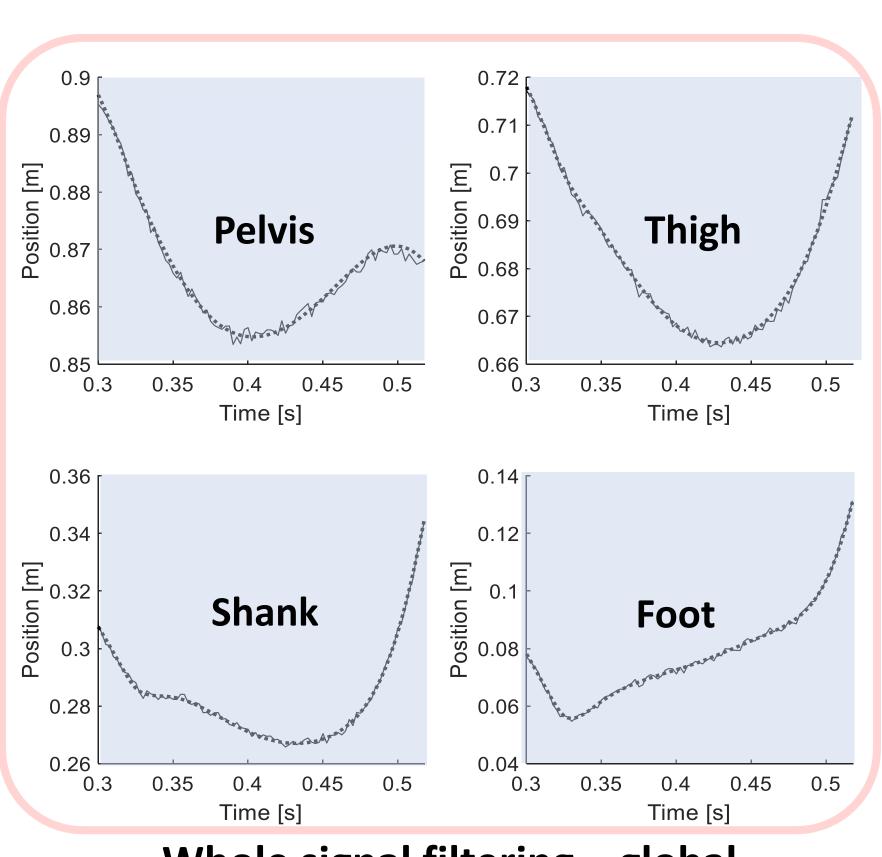
## Introduction

- Filtering noisy biomechanical kinematic signals may require a more flexible approach than is currently used.
- Recently proposed approach better approximates acceleration from single noisy signal [1].
- New procedure applied in estimation of vertical ground reaction forces (vGRF).

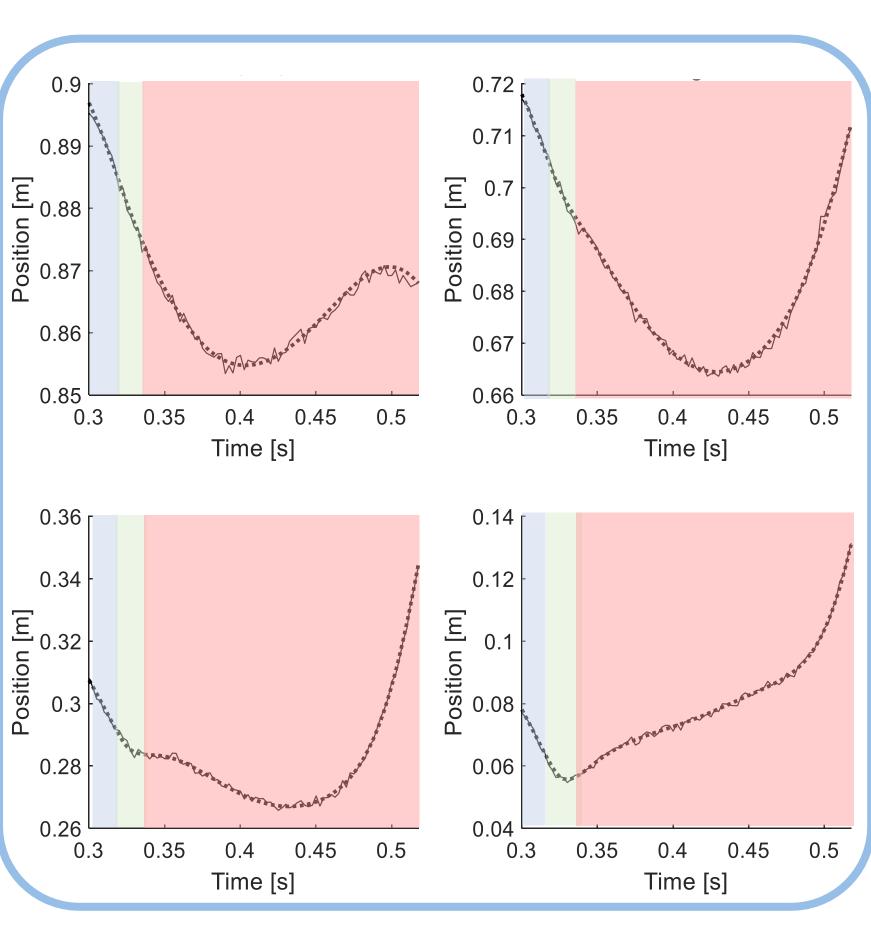
## Data - Noiseless kinematics and vertical ground reactions forces **Pelvis** from four-link simulation of ····· Noiseless \_\_\_\_\_ 1.0 mm noise SD human running [2]. - White noise added to center of mass position signals (five different noise levels). Time [s] Thigh 0.68 0.45 0.5 Shank Time [s] Foot 0.14 г 0.36 г <u>느</u> 0.32 -Time [s] Time [s]

## Filtering Approaches

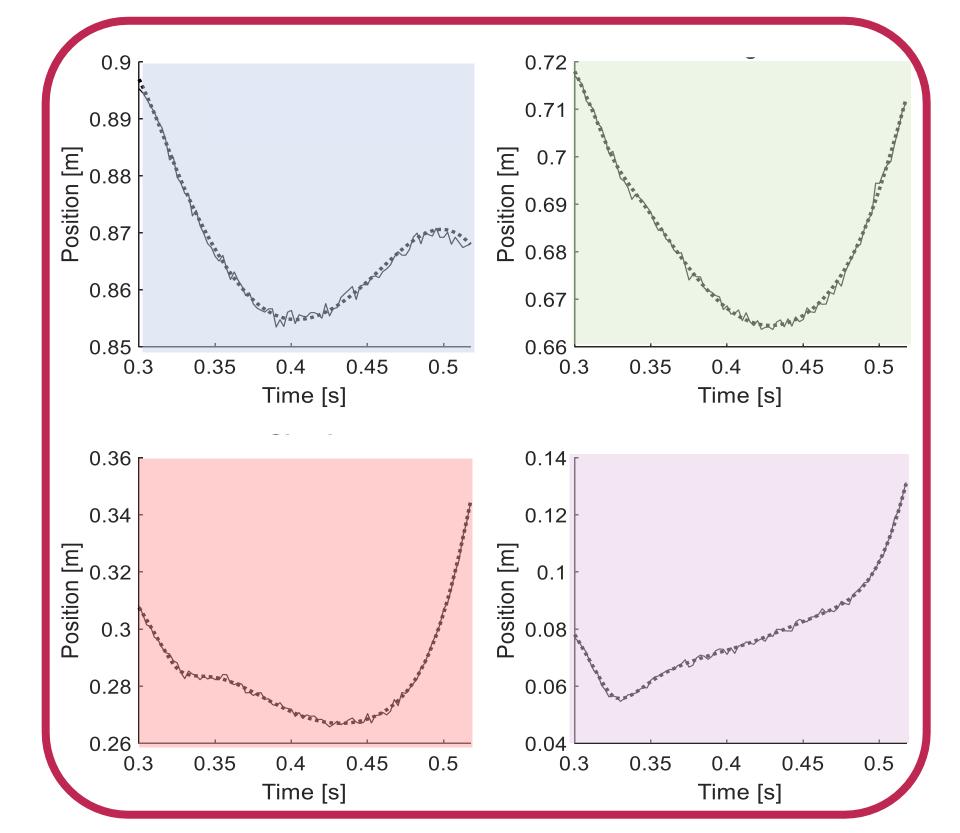
- Filter cut-off frequencies determined using Autocorrelation Based Procedure [3].
- Signals sectioned using Teager-Kaiser energy [4] of vertical ground reaction force estimated from WF-G approach.
- Different colors represents a different filter cut-off frequency used on that portion of noisy signal.



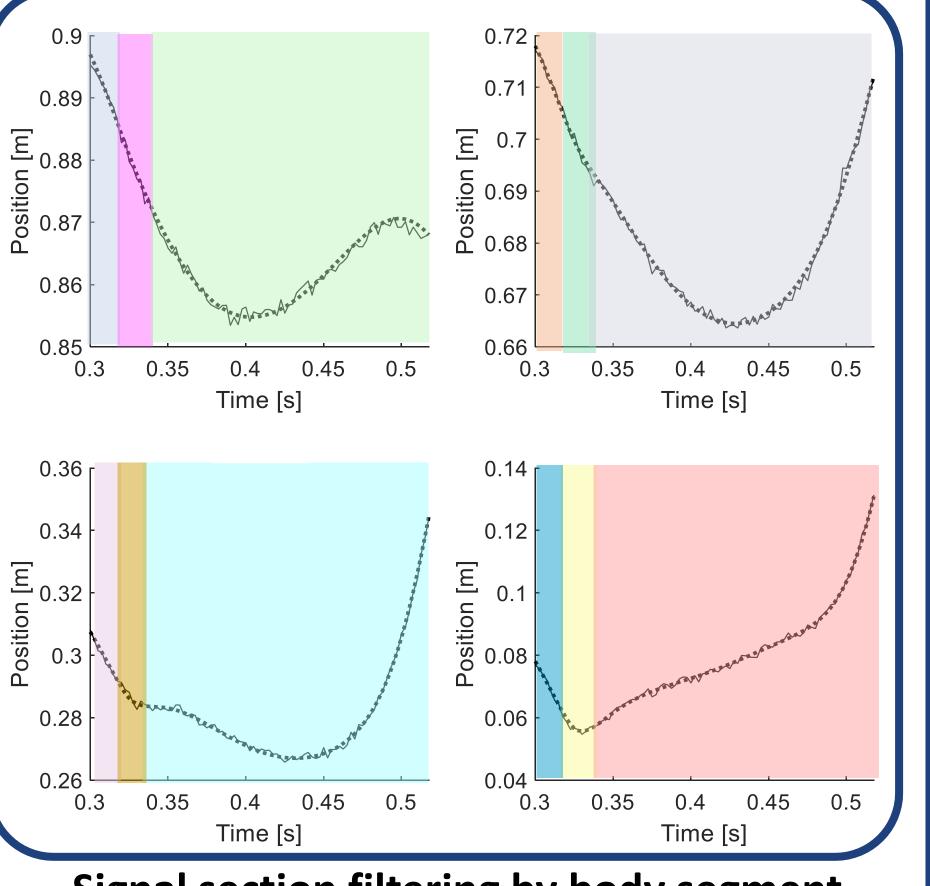
Whole signal filtering – global (WF-G); Common Approach



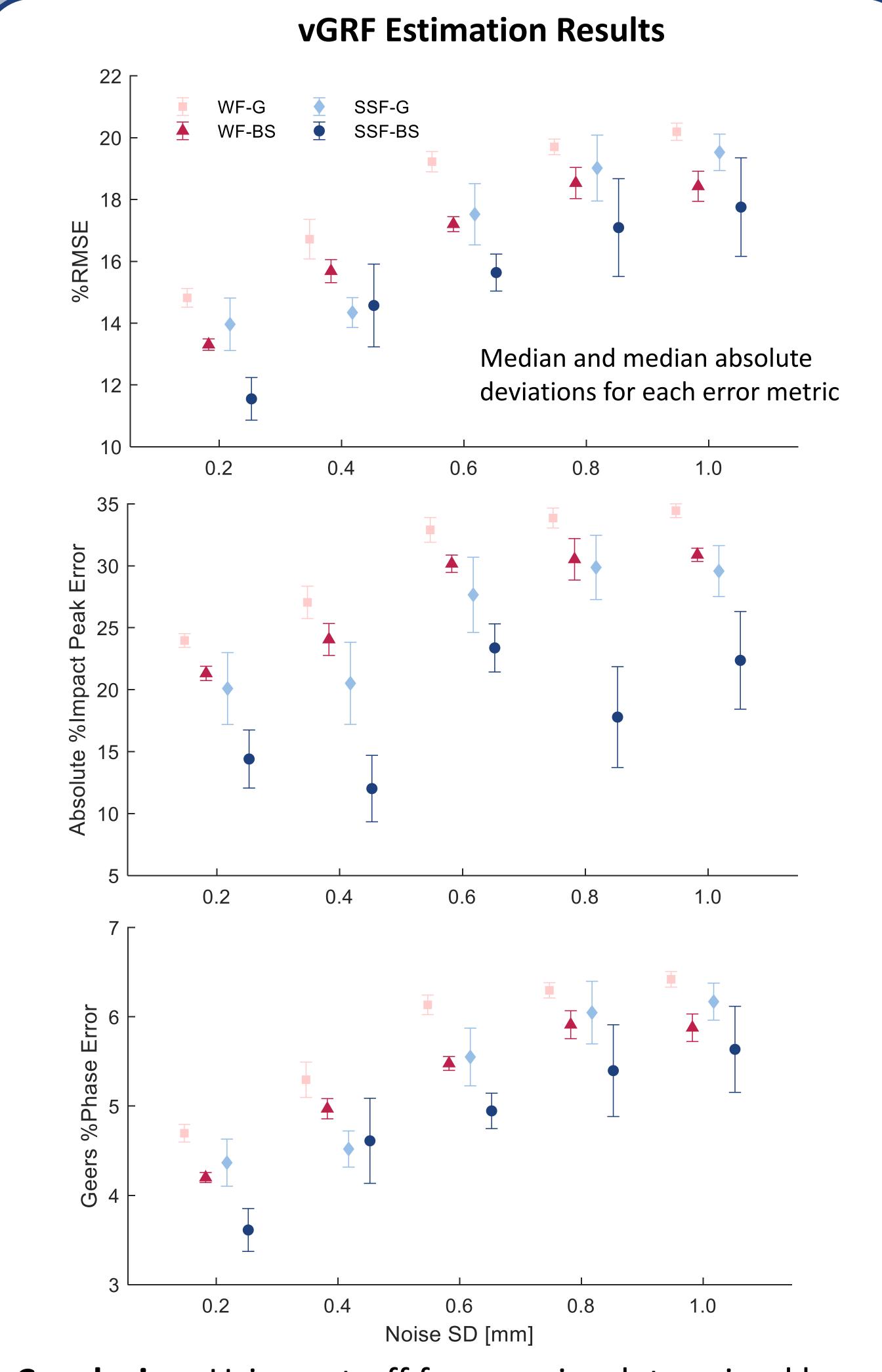
Signal section filtering – global (SSF-G)



Whole signal filtering by body segment (WF-BS)



Signal section filtering by body segment (SSF-BS); New Approach



**Conclusion:** Using cut-off frequencies determined based on local signal characteristics improves estimation of vertical ground reaction force compared to common biomechanical signal processing techniques.