Extracting and Interpreting Unknown Factors with Classifier for Foot Strike Types in Running

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Background

1

- **Actualization of automatic coaching systems**
  - **many people can improve their skills more efficiently and effectively than now**
  - **can avoid injuries.**
- **Related works**

Most of related works use machine learning, and predict evaluations based on experts' criteria, which could be biased.

For example:

Deep learning systems learns diving players' scores given by judges and estimates unknown diving players' scores [1].

⇒ But, not helpful to extract **new knowledge** for the experts

[1] P. Parmar and B. T. Morris, "What and How Well You Performed? A Multitask Learning Approach to Action Quality Assessment," CVPR, 2019, pp.304-313.

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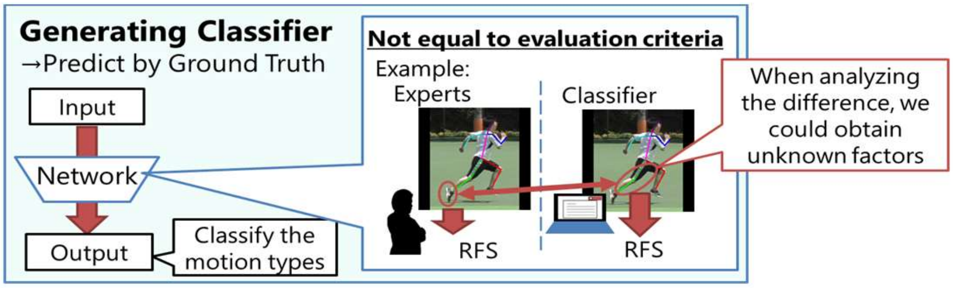
Goal

○**Extract and Interpret Unknown factors** (experts do not know and/or did not experience) **from Classifier**



○**Case study：Foot strike type during running motion**

①Evaluation criteria as ground truth is clear.

RFS type: the heel contacts the ground first.
Non-RFS type: other case of contacting the ground to RFS

②Interpreting unknown factors in terms of many sport science knowledges about the foot strike.

2

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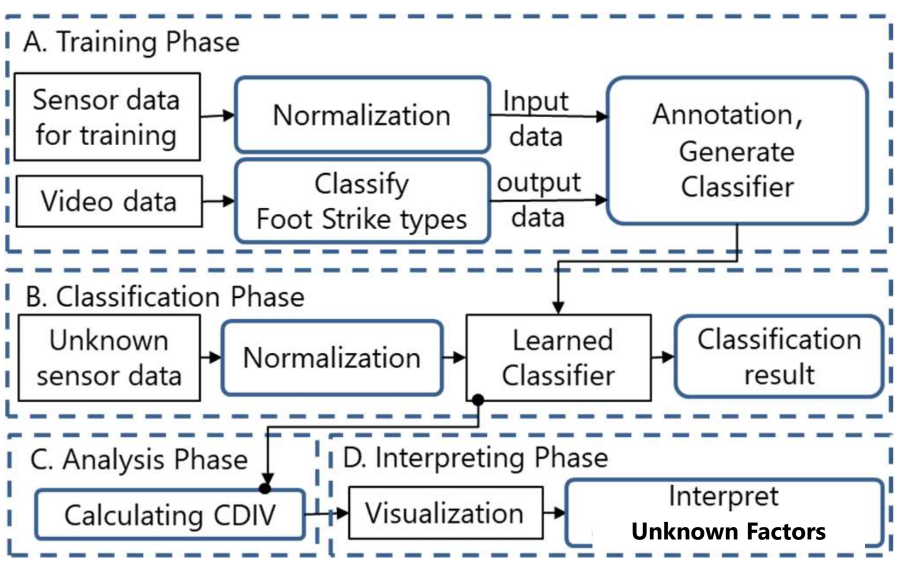
Overview of Proposed Method



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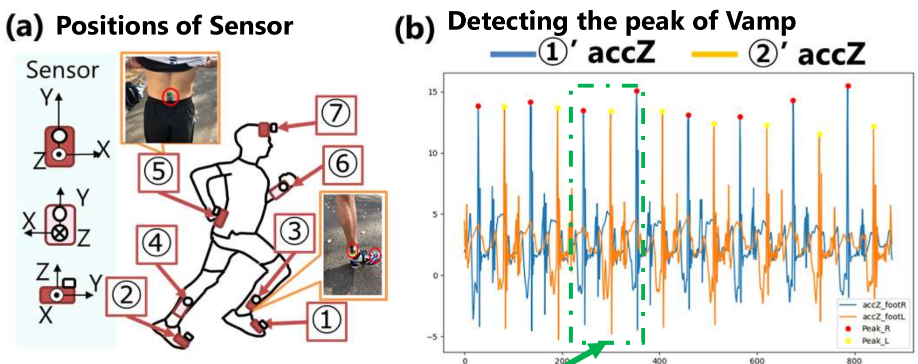
Training Phase & Classification Phase

- 7 accelerometers for measuring running motions.
- Foot strike type for runners is evaluated by videos



①Right Vamp, ②Left Vamp, ③Right Tibia, ④Left Tibia, ⑤Lumbar, ⑥Left Wrist, ⑦Forehead

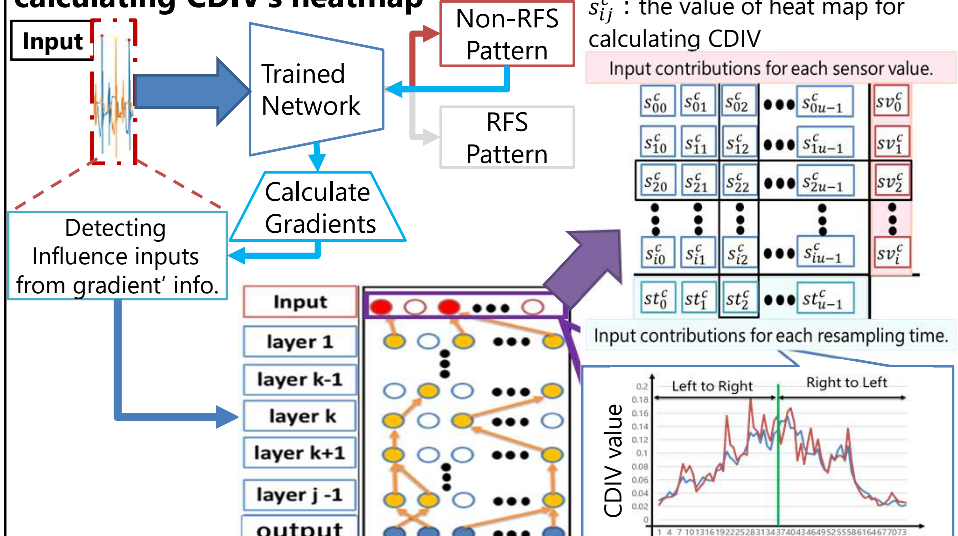
To normalize the peak to peak, we do resampling: 37, 74 and 148

Analysis Phase & Interpretation Phase

○Detecting influence of input by calculating CDIV's heatmap

$CDIV$: the degree of influence of the input on the output in DL

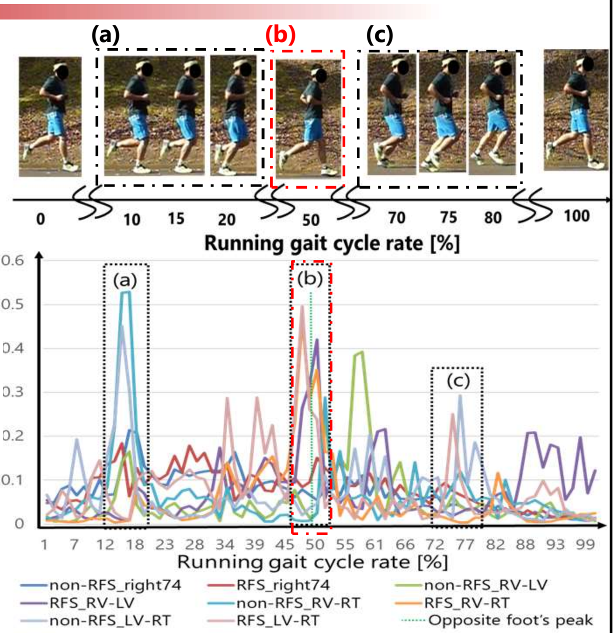
s_{ij}^{c} : the value of heat map for calculating CDIV



Unknown Factors

- Fig.(b) is classified as RFS type around contacting the ground
→ Same as annotation of foot strikes by videos

- From Fig. (a) and (b), it turns out that swinging leg is related to classifying foot strike.
→ In general, the swinging leg is considered to play more important role in improving running skills than classifying foot strikes.
(unknown factor)



6

Thank you for your listening!!

7