

## Reply

# Reply to Letter to the Editor, by Mikael Forsman, Xuelong Fan, Ida-Märta Rhén and Carl Mikael Lind

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We would like to thank Forsman *et al.* for the letter concerning our commentary paper ‘Action levels for the prevention of work-related musculoskeletal disorders in the neck and upper extremities: a proposal’. We appreciate the important discussion concerning one of our 13 action levels, i.e. how to record arm velocity.

When we began recording arm velocity in the early 1990s, there was no commercially available wearable equipment. Thus, we built our own, based on three uniaxial accelerometers which were mounted mutually orthogonal and moulded in silicon rubber (Hansson *et al.*, 2001). Due to historical technical limitations, using accelerometers only since gyroscopes were not available, we have defined generalized angular velocity according to Hansson *et al.* (2001). The generalized angular velocity obtained by gyroscopes + accelerometers (IMUs) is more correct, as indicated by Fan *et al.* (2021). Despite knowing this, we have kept the same method in order to build a database over time. This has made it possible to calculate exposure–response relationship between ergonomic exposures and musculoskeletal disorders (Balogh *et al.*, 2019). The data collection for this has taken a long time, and if we had changed the technical methods, we would have had to start all over again.

It is very encouraging that there are now new, more user-friendly methods that can be used by both practitioners and researchers. This is necessary for a broad use of technical measurements in ergonomic risk assessment—which in turn is needed to be able to apply occupational exposure levels.

As various ways to record and calculate arm velocity lead up to different results, we fully agree that it is very important to present which methods that are used. As pointed out by Forsman *et al.*, this applies both to sensor type and computational method. The suggested action level of 60°/s applies for three-axial accelerometers, where the generalized angular velocity is calculated according to Hansson *et al.* An important job for the future is to agree on both sensor type, filtering of data and whether inclination velocity or generalized angular velocity is the most relevant. We look forward to the continued discussion.

### Conflict of interest

The authors declare no conflict of interest relating to the material presented in this letter to the editor—a reply. Its contents, including any opinions and/or conclusions expressed, are solely those of the authors.

### References

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