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Title: **Terminology for Control of Upper Limb Prostheses**

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ABSTRACT

The recent introduction of novel multifunction hands and new control paradigms has caused a divergence of practice and terminology that reduces readability and complicates comparison of different contributions in prosthesis control [1].

In order to 1) improve the understanding of the subject, 2) stimulate to more structured research, and 3) improve the communication between researchers, clinicians, users and other people involved in prosthetics, we propose an unambiguous taxonomy for the upper limb prosthesis control problem.

An example of a confusing term that we have needed to clarify is *training*. It can be used about a control system's adaptation to a user (for example by training a pattern recognition system), but it may also be used about a prosthesis user's adaptation to a prosthesis (i.e. learning how to use the prosthesis). We have referred to these processes as *system training* and *user training*, respectively.
Fig. 1. A functionally partitioned model of the prosthesis control problem. One example (The Boston arm) is presented along with the model.

Another example is the term *simultaneous control*. It has sometimes been used about prosthesis control systems that are able to exhibit various functions, such as different grip patterns in a hand prosthesis, even if they can never be performed simultaneously in time. This misunderstanding needs a correction and we suggest to use the word *simultaneous control* only when functions can be peformed simultaneously.

Many technical terms are frequently confused, e.g. *preprocessing*, *feature extraction* and *parameter estimation* or *degrees-of-freedom*, *motor functions* and *motion classes.* Such terms can be explained and compared by clearly definining the terms, giving suitable and possibly illustrated examples, and fitting the examples into a good model.

Results:
We illustrate the relationship between some of the various terms commonly used in prosthesis control by presenting a functionally partitioned model and a corresponding taxonomy for the prosthesis control problem in Fig. 1 (on the next page). The model is made in order to fit all prosthesis control systems, and one such system is shown as an example. Our results also include a list of 23 definitions with examples.

We have attempted to include all of the existing terms in the suggested terminology, but in cases where expressions have been used in confusing ways or in ways conflicting with other professional fields, we have introduced new terms or redefined existing terms for clarification.

The suggested terminology is applicable to control systems for upper limb prostheses and also to prostheses in general.

References:

[1] Fougner A., Stavdahl Ø., Kyberd P. J., Losier Y. G., and Parker P. A., "Control of Upper Limb Prostheses: Terminology and Proportional Myoelectric Control – A Review", in *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, submitted for publication.

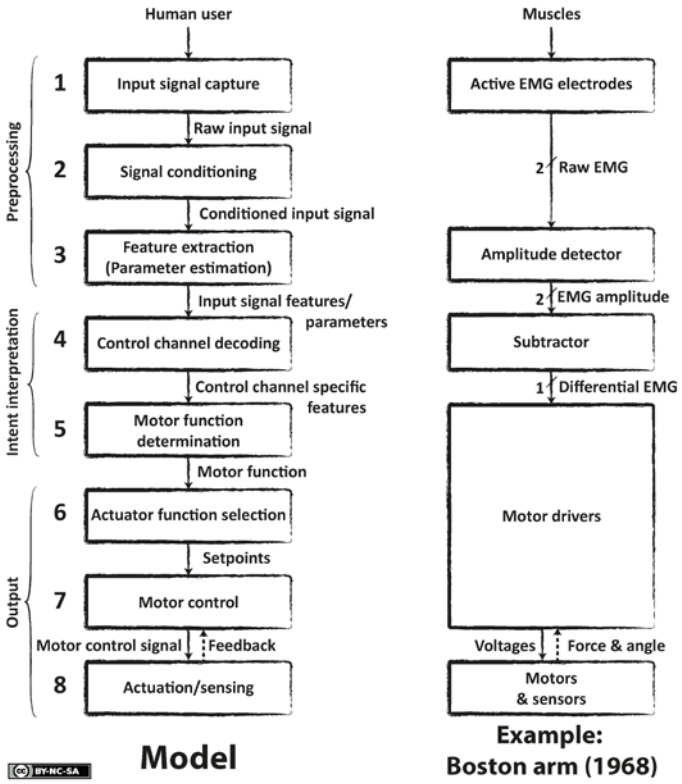

Fig. 2. A functionally partitioned model of the prosthesis control problem. One example (The Boston arm) is presented along with the model.