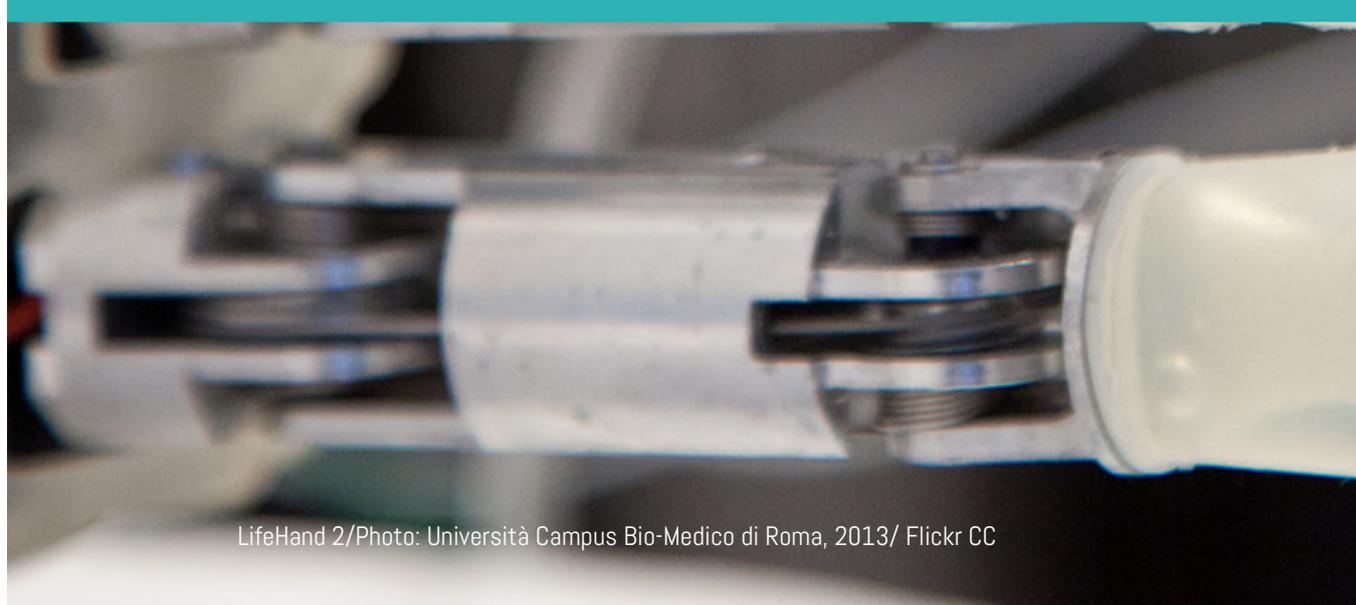




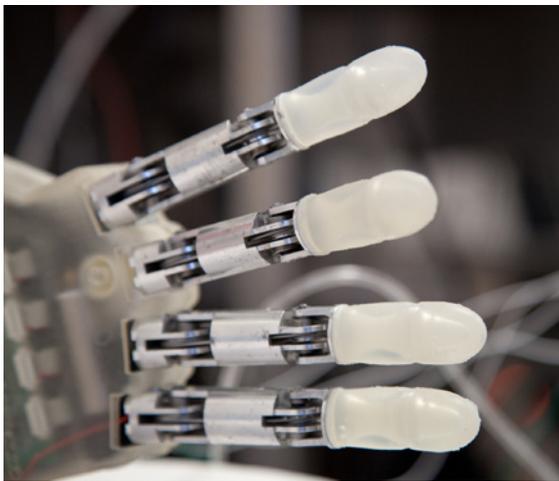
Nathanaël Jarrassé  
**Robotic prostheses:**  
what do they actually mean  
for the patient?



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# Robotic prostheses

Prostheses have undergone an accelerated development over the past few years, triggered by, amongst others, the conflicts in Iraq and Afghanistan. Indeed, with their share of wounded and amputees, these conflicts will undoubtedly have made a strong contribution to, putting the spotlight on this niche field of research. The technological sophistication of robotic prostheses gives free rein to the imagination. But what is the reality on the ground? As we speak more and more of the augmented man and body-machine fusion, what does this all actually mean for the patient? To shed some light on this matter, we put our questions to Nathanaël Jarrassé, a CNRS researcher at the Institute of Intelligent Systems and Robotics at the Pierre and Marie Curie University in Paris.



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## Between techno-utopianism and radical technocriticism:

To caricature the issue, commentators on robotic prostheses hover between techno-utopianism and radical technocriticism. For the former, technology represents a hope that reaches its climax in the form of augmented man. For the latter, this technology offers both the possibility of a qualitative leap forward for man but also a danger in the form of a change so radical that man would lose all resemblance to a human. For Nathanaël Jarrassé, even if these two positions seem to be contradictory, they both serve to build up the patients' hopes and their representations, while being «far removed from the reality of the patient and the scientific reality». For him, one of the most convincing examples is the rhetoric of some non-specialists on the technological risks.

“The problem is that even if the intentions are generally commendable and the issues are very much present, they sometimes construct a rhetoric on a perception of technologies and practices that are not at all based on a technical reality. It sustains myths, beliefs and a kind of ideology.”

We often forget the hours of training necessary to use a prosthesis, the discouragement, the failures, the return to the good old mechanical or aesthetic prostheses.

Oscar Pistorius is held up as an example, but what they forget to say is that, to keep his balance, he has to hop on the spot, and that if he wants to swim or simply walk, he must change prosthesis. All this is a significant constraint. It's a world away from the adaptability of a human lower limb. Some predict that soon we will be amputating a limb in order to gain in physical performance but what about the damage to the body map and the pain of the phantom limb? What about the unrivalled versatility of our bodies?



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He does not deny that this rhetoric is also generated by the scientists themselves. «It's actually a multi-scale problem. The relationship between technological innovation, the general public and the researchers who created it is influenced by numerous agents in the social, cultural and commercial fields, and among them, in particular, popularisation and mass scientific communication. Because popularising inevitably means simplifying. But there is so much content that, in the end, it becomes distorted.» According to Nathanaël Jarrassé, some researchers who are not technological specialists, government agencies, the media and the general public form a kind of ecosystem that contributes to the emergence of these myths. «For example, when government agencies make calls for funding, this is done through themes that, in actual fact, are influenced by cultural myths. Sometimes we'll find keywords or illustrations that are straight out of the realm of science fiction rather than a technological reality. "The researchers themselves" use this to sex up their research. They will cling to a certain cultural myth, they will make analogies with films». This is obviously not without perverse effects because researchers sometimes find themselves caught up in their own sexed-up rhetoric: «It may seem benign but reporting and transforming can ultimately put pressure on research. In fact, this gives the impression that there is a gap between research and its popularised version, eliciting reactions such as "you've only reached that point". The disappointment for the patient will also be significant.

It is, therefore, undeniable that researchers have their share of responsibility. «But in their defence, it is very difficult for researchers to talk to journalists about their research. It is a complex exercise. I think that, in the long run, we should have training in «communication». We have to realise that a word, if it has links with a cultural object or a myth, can trigger a train of thoughts in a journalist who is not a specialist in the field and put him on the wrong track.”



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### Reflection on his research:

Even if there is truth in the criticisms that researchers have tunnel vision and do not think enough about their research, there is nevertheless a growing fringe of scientists who are aware of this need. For Nathanaël Jarrassé, this vision of the researcher can be put down to the over-representation of certain «spinners» such as Kevin Warwick or Hiroshi Ishiguro; the former who proclaimed himself «the first cyborg» while the latter makes robots in his effigy and that of his entire family. For Nathanaël Jarrassé, «they are anecdotal people who are media hungry but who are not at all representative of the community». It is important to note their significant presence in the media. The taste for sensationalism is undoubtedly the cause.

Nevertheless, the engineer pointed out another difficulty: «Researchers have a hard time publishing studies carried out in conjunction with anthropologists or sociologists.» While the research community is well aware of the need for reflection on their research, interdisciplinary work does not seem to go down well in scientific journals. And yet, it is only through this interdisciplinarity that we can ask ourselves the right questions. There is obviously no question of turning a physician or a physiotherapist into an engineer or an indeed an engineer into an anthropologist. No, however, there is a need to work together, to create so-called co-designs. But it isn't easy.

What should be done to promote interdisciplinarity? Nathanaël Jarrassé replies: «For example, by considering real funding that encourages these disciplinary combinations. The fact

is that, even if this type of research interests the researchers, they are forced back into their technical reality because they must publish in engineering journals. In order to raise substantial funding (spread over several years to finance equipment and human resources), they will have to work in truly technical fields. There is no guarantee of money being thrown at an interdisciplinary analysis that will obviously be slower. Thus, researchers are torn between research that is driven by slower ethical issues and a certain pressure that forces them to come up with the results.»

While medicine is making some headway in this field, it is also true that, in most cases, co-design is still a matter of wishful thinking. While, for example, a sociologist may be involved in a research project, this integration is rarely done upstream. If he intervenes, it will very often be after the fact and brought on board to work on its social acceptability. Obviously, this can only cause frustration for social scientists. Nevertheless, things are changing: “thanks to the CNRS (and its mission for interdisciplinarity) and recently to the ANR (French National Research Agency), we are working on the use of phantom signals for the control of prostheses. To do so, they have brought on board a clinical equipment centre, a neuroscience and neurophysiology laboratory, a robotics laboratory, a company that develops printed electrodes as well as a sociologist. This team has been put together

to work around a product relating to the phantom limb. It's not easy and there are trade-offs to be made. When the experiments take place, everyone is there. The question is why would a sociologist attend the kinematics or electrophysiology measurements. In fact, the idea is to ask for everyone's opinion and discuss it afterwards and try to take it into account when defining a system. We are very fortunate to have been able to create this and we have many colleagues who would like to follow suit, but who do not always have the framework or the funding to make it happen.”

There is indeed an ethical reflection on the development of therapeutic robots. The Allistene Digital Science and Technology Research Ethics Commission (CERNA <http://cerna-ethics-allistene.org>) has issued an ethics report for research in robotics. It is a first step that lays the foundation for a reflection on major problems: «The problem of defining the robot, the scientific communication of researchers with regard to the general public, the dangers of robotic links with the body and the links between robotics and vulnerable persons (elderly people, autistic people, etc.), the risk that may arise with robots that are involved in social interaction, the power that this can have on some vulnerable people. In fact, the community, at least in robotics, is aware of this and has been thinking about these kinds of issues for a while”.

### Patient integration and validation

The integration of the patient, moreover, upstream of the project, remains the major challenge. Nevertheless, the emphasis is increasingly on this component, to avoid hearing observations such as: «I sometimes have the impression of building houses on sand». Indeed, what the patient wants is sometimes far removed from what the researcher has planned for him. Comfort, the aesthetic aspect and discretion can sometimes override the functional aspect. This is why sitting down with the patient to discuss his expectations and life plan before the design of the finished product is paramount if he does not want it to end up in a cupboard. «Even if this represents one more step in the already long process of co-design».

But even before thinking about integrating the patient at the beginning of the project, another seemingly essential step also appears difficult to roll out in practice: the evaluation of what has been developed and the clinical tests carried out. Often, projects remain blocked at the «proof of concept» stage - in other words, at the scientific discovery stage. In general, the idea will be validated but the transfer to the patient, the development of something that will be useful for him and exploitable tends to be shelved". Lack of time and funding seems to be the cause. When Nathanaël Jarrassé is questioned about the waste that this can generate, he becomes rather impassioned: «When you see the lavish string of exoskeletal platforms created and developed

## Robotic prostheses

for the rehabilitation of the upper limb! There are around fifty worldwide, and this, of course, by different laboratories. In addition, if we look more closely at those that have been clinically or pre-clinically tested, there are no more than 8 to 10 in total. In fact, very often the device is only validated on healthy subjects but we rarely go on to the next stage". Funding policies should therefore take this validation step into account or allow improvements to already existing devices, especially in the medical field. Innovation is nothing if it is limited to proof of concept.



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