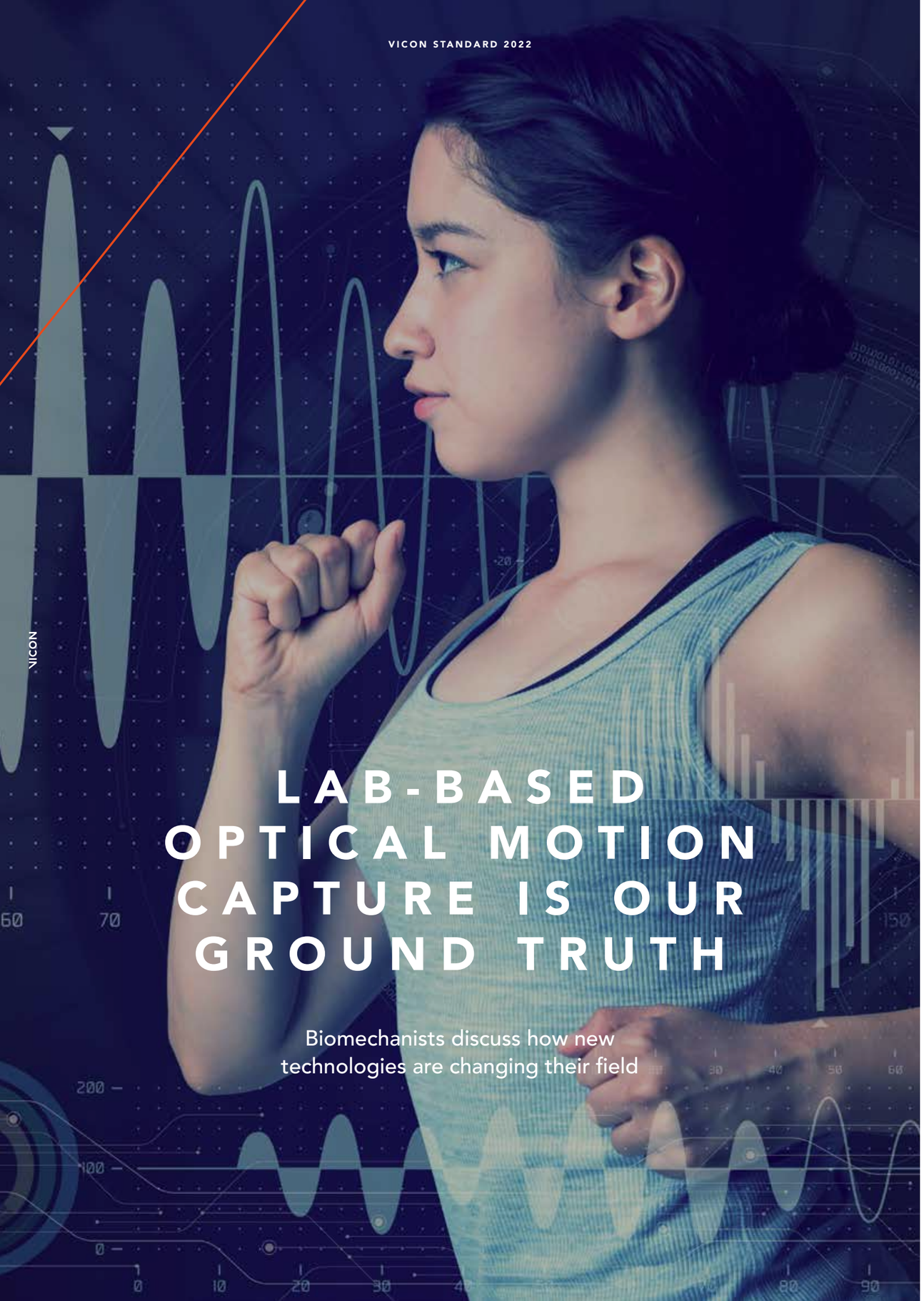

LAB-BASED OPTICAL MOTION CAPTURE IS OUR GROUND TRUTH

Biomechanists discuss how new technologies are changing their field

Dr Jacqueline Alderson, University of Western Australia

Dr Stuart McErlain-Naylor, University of Suffolk, UK

Dr Laura-Anne Furlong University of Limerick, Ireland

Dr Helen Bayne University of Pretoria, South Africa

Dr Lanie Gutierrez-Farewik, KTH Royal Institute of Technology, Stockholm

New motion capture technologies such as inertial and markerless tracking are opening new frontiers in biomechanics, while core optical solutions are evolving rapidly and consumer-grade devices are bringing big tech into the field. Vicon convened a panel of leading biomechanists to discuss how these changes are affecting their work, and the importance of lab-based, research-backed optical capture to ground new developments.

For some of the panelists, recent leaps forward in motion capture have been transformational. "We're very heavily reliant on some new developments in high-speed motion analysis systems," said Dr Laura-Anne Furlong of University of Limerick, Ireland, who is currently studying plantar flexor mechanics and the mechanics of the lower limb.

"You simply couldn't do that work manually. Even using older camera systems or older software processing, you couldn't do that type of work. So our work is very dependent on the technology we've developed in-house or procured from the likes of Vicon."

There was a consensus among the panel, however, that researchers shouldn't pursue a route of inquiry simply because technology enables it. "It was trained into us by Professor Bruce Elliot and others that we should only ever use tech to inform research questions, never to drive them," said Professor Jacqueline Alderson of the University of Western Australia.

"Most of the uses of machine learning at the moment in terms of motion capture are pose estimation techniques that essentially reinvent what we did 30, 40, even 50 years ago. So what we are doing right now is creating tools that reduce our labor," Alderson added.

Rather than dictating research routes, says Dr Helen Bayne of the University of Pretoria, South Africa, technology is allowing researchers to approach existing routes from new angles. "The starting point is still asking good research questions, but the advances in technology are definitely enabling us to approach those research questions in different ways.

"Especially changing the things that we can measure accurately, and I think, changing the different environments that we can measure those things in, and how we can assimilate different data sources," said Bayne, who is researching sports performance and injury mechanisms.

THE ENTRY OF BIG TECH

While the panelists enthused about the possibilities offered by new technology from established motion capture companies such as Vicon, they expressed trepidation about the increasing encroachment of big, non-specialist tech companies into biomechanics.

"Researchers are under increasing pressure to collaborate with industry," said Alderson, whose current main focus is on using machine learning to enable lab-grade insights in the field. "I hear a lot of them saying 'that's good enough. That's close enough'. And unfortunately, it's not close enough. Because a commercial entity has different drivers and needs to monetize their data, they might be happy with data that's 60% accurate. It's a long way from what our profession should be looking to give back to someone, especially when we're talking about clinical and sports populations.

"It's not about just sending out smartwatches to the general consumer health and fitness sector. It's about dealing with real populations that have marginal degrees of sensitivities that we need to be able to inform, because the real importance of our discipline is the people, and how we talk to people, how we translate the meaningfulness of that data, how we contextualize it. Technology can't replace that."

"From a public perspective, it increases the importance of our science communication," agreed Dr Stuart McErlain-Naylor of the University of Suffolk, UK. "It's not that this tech is good and this type is bad. It's asking what are the positives and negatives? What are the limits?"

Professor Lanie Gutierrez-Farewik, of KTH Royal Institute of Technology, Stockholm, said that biomechanists should take the lead on how such tech is used.

"We as scientists can help determine precisely under what conditions data is accurate or valid enough," said Gutierrez-Farewik, whose work examines the link between underlying function and motor performance in walking. "The consumer technology companies aren't going to draw that line for us."

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McErlain-Naylor, who is currently exploring sporting technique in his research, added a note of optimism about possibilities opened up by the sheer volume of wearable activity monitors out in general populations. "In terms of big data, so many people all over the world are wearing these devices 24/7, and so there are now these huge datasets of physical activity from people in various populations. If researchers are able to tap into that, I think that could open up some interesting avenues for research."

"As long as we can accept that there's a pretty big margin of error, as long as the right question allows for that, the possibilities are huge. But the question needs to be relevant," said Gutierrez-Farewik.

'GROUND TRUTH'

The panelists stressed that each new development, whether it comes from an established motion capture company or a consumer brand, needs to be grounded in clinically-validated data gathered in a lab setting.

McErlain-Naylor warned of a potential rift in the field of biomechanics. "Your theoretical computational biomechanics will become more and more computationally advanced and more theoretical, but then you could have another branch of biomechanics moving in the opposite direction and getting quick and easy results in the field," he speculated.

"I think the challenge becomes bridging the two, and taking the theoretical advances and making sure they're actually applied out in the field; essentially that the two sides are still linked together and informing each other as one field," said McErlain-Naylor.

"There's always going to be a place for lab measurements," Gutierrez-Farewik agreed. "But there are, of course, more and more questions and applications for outside the lab, whether it's with wearables or markerless. That's just exploded over these past few years. It's tempting to hope that that's a holy grail, and you won't need labs anymore. But it's really important that we analyze and understand how much we can trust this data. And that's a huge technical challenge."

Alderson went a step further, saying that it's important to consider not only the validity of data collected with new technologies, but also whether the measurements are the ones biomechanists really want.

"I think there will always be a place for lab-grade data because it's our ground truth," Alderson said. "What I'd love to see is tools to bridge that lab/field nexus. But that doesn't mean that we create tools that just allow us to collect surrogate measures to stand in for what we really want to collect in the lab."

Alderson said that she wants to see measurements taken in the field that truly replicate those that can be taken with an optical system, but that for the moment that data remains locked in the lab.

In other words, while new technologies continue to open up new possibilities for study in biomechanics, they can't replace the power of lab-based solutions, which remain essential as the gold standard in motion capture.

I think there's always going to be that place for lab-grade data collection," concluded Furlong. "I think that you're always going to have to have a lab-based setting to compare new technologies back to."

For more on the current state of biomechanics, see Vicon's panel discussion on our YouTube channel.

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