

Medical ultrasound diagnosis in the near future as we move toward the era of the singularity

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Introduction

It is said that we are moving toward the era of the technological singularity [1]. According to Kurzweil, the singularity is a future period during which the pace of technological change will be so rapid and its impact so deep, that human life will be irreversibly transformed. Although I am not sure at this moment whether artificial intelligence (AI) superior to us will emerge and overcome humans, I am pretty sure that medical ultrasound diagnosis will dramatically change in the near future because the progress of human-created technology is accelerating at an exponential pace. I imagine the following three great changes that may happen in medical ultrasound diagnosis.

Telemedicine using intelligent navigation sonography

Telemedicine is widely used so that experts can see images and make a diagnosis remotely. For example, telemedicine using three-dimensional (3D) and four-dimensional (4D) sonography with spatiotemporal image correlation (STIC) facilitates examination of the fetal heart. In prenatal ultrasound diagnosis of a fetus, however, fetal lie, presentation, and position can affect the configuration of standard diagnostic planes. Yeo and Romero proposed the term ‘intelligent navigation’ to refer to a new method of interrogation of a volume dataset whereby identification and selection of key

anatomical landmarks allow the system to: (1) generate a geometrical reconstruction of the organ of interest and (2) automatically navigate, find, extract, and specify diagnostic planes [2, 3]. They accomplished this using an operator-independent algorithm and developed fetal intelligent navigation echocardiography (FINE) based on STIC datasets. I expect that such techniques will be established not only in fetal echocardiography, but also in obstetric ultrasound and other medical ultrasound diagnosis.

Telexistence sonography

As Yeo and Romero mentioned, telemedicine using intelligent navigation sonography is not intended to replace the performance of real-time fetal echocardiography, in which only the latter can evaluate cardiac function, cardiac rate, or rhythm disturbances at the present time [2]. And no matter how far telemedicine progresses technically, there may be situations where experts themselves want to remotely perform ultrasonography to make a detailed diagnosis. Telexistence, tele-existence, or telepresence, is an advanced form of tele-operation, which enables a human operator to remotely perform tasks with dexterity, providing the user with the feeling that he or she is present in the remote location [4]. I am looking forward to seeing such real robot control systems becoming a reality in medical ultrasound diagnosis.

Automated image acquisition and diagnosis by AI

This could become a reality as we approach the era of the singularity. Some would say that we cannot comprehend the singularity, at least with our current level of

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understanding. Beyond that, of course, I cannot imagine the future of human beings.

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