Better brain scans by correcting for movement

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Video Abstract

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Abstract

Brain scans are powerful tools for diagnosing disease, monitoring treatment, and conducting basic biological research. But slight head movements can impair image quality. Now, researchers have devised an improved method to significantly reduce this problem for a dual scanning technique called magnetic resonance – positron emission tomography, or MR-PET. Magnetic resonance, the basis of MRI scanning, builds images from the response of selected atoms in the body to radio waves under a strong magnetic field. Positron emission tomography, PET, builds images by detecting particles called positrons released by radioactive tracers after they are allowed to spread through the body. MR-PET combines the two techniques, offering advantages over either alone. But it takes a long time, as much as 90 minutes, to acquire the data to create MR-PET images. So, image-blurring artefacts and quantitative errors due to head movements can become a problem. The researchers tackled this issue using a process called image co-registration. The process combines a series of multi-contrast MR images by aligning them to one reference image. This provides information about tiny head movements that can then be used to correct simultaneously acquired PET images. The procedure is fully automated, requiring zero human intervention. The team tested their procedure by first instructing one person to make specific head movements at regular intervals during a scan. The insights gained were then used to correct PET images obtained from 10 people who had been instructed to keep their head movements to a minimum. The sharpness of the corrected images was 12 percent greater than that of uncorrected PET images, and 7 percent greater than that of images corrected using existing correction techniques. One limitation of the method is the absence of motion information if MRI and PET are not active in acquiring images, such as when switching image contrasts in MRI. But overall, the procedure is highly capable of removing PET image artefacts and errors that could mislead doctors. The most obvious application of the procedure is improving the MR-PET diagnostic accuracy of diseases and monitoring their progression and response to treatment. But it will also help researchers understand the basic science that underlies normal brain activity. The physiological pathway of the PET tracers can be monitored as they participate in metabolism. And local and global structural and functional information about the brain can be measured by MRI. Using a hybrid MR-PET scanner, researchers could therefore gain a better picture of complex brain physiology and metabolism.