CHAPTER V

Results

Figure 4.3 shows a diagram of the hybrid spiral 3D TRF one shot of a two-shot pulse. The first and second rows from the top show real part and imaginary part of RF pulse respectively, that perform by Eq 4.1 as described above. The third, fourth and last rows show the x, y spiral gradients and z blip gradient. The pulse width of the hybrid 3DTRF pulse is 13.8 ms. The designed pulse is breaking up into 2 shots as half pulse along z-direction and multi-shot along x-y-direction to reduce both TE and susceptibility artifact[19,20,22]

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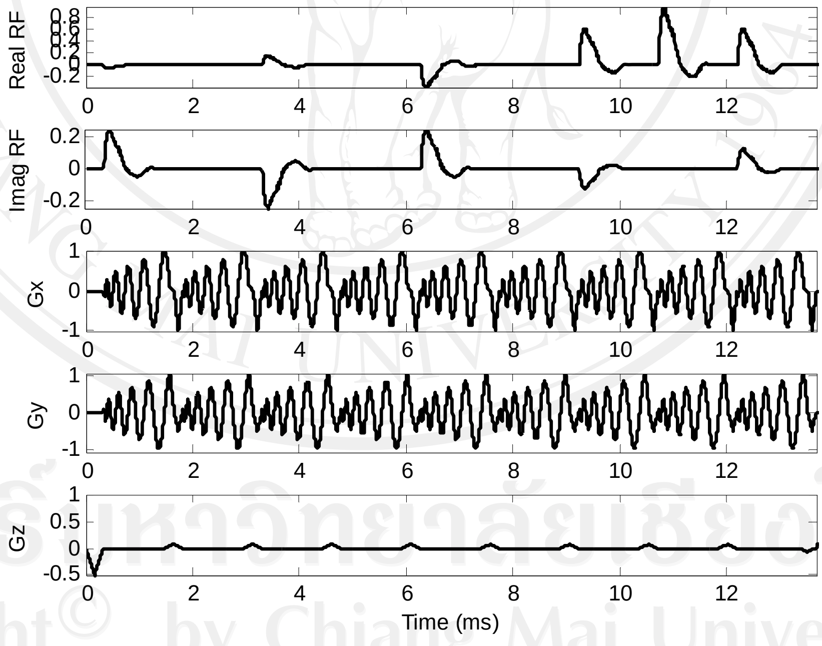

Figure 4.3 Diagrams of one shot from a two-shot hybrid spiral 3D TRF pulse use for small volume excitation. The first and second rows from the top show real part and imaginary part of RF pulse respectively. The third, fourth and last rows show the x, y and z gradients.

The sampling reduction of the 3D hybrid pulse with spiral trajectories was achieved by applying variable density sampling [8], breaking up the k-space into multiple shots

[22] and using a half-pulse design [19, 20] to reduce the pulse width. The transverse magnetization, M_{xy} that was calculated using numerical simulations of the Bloch equation was generated from the corresponding pulses. The optimum numbers of sampling from the hybrid was 3421 while the conventional 3D TRF pulse was 5198. Figure 4.3 shows result from the numerical simulation of the transverse magnetization M_{xy} obtaining from the hybrid and conventional 3D TRF p ulses that excited for a 12x12x10 cm^3 of cylinder in a 24x24x20 cm^3 field of view. Figure 4.4 a and b show mesh plots of M_{xy} in x-y plane and x-z plane of both methods. Visual inspection of fig. 4.4 (a, left) shows slightly aliasing outside the excitation FOV in x-y plane, but shows better transition profile in x-z plane compares to that of in fig. 4.4 (b, left).

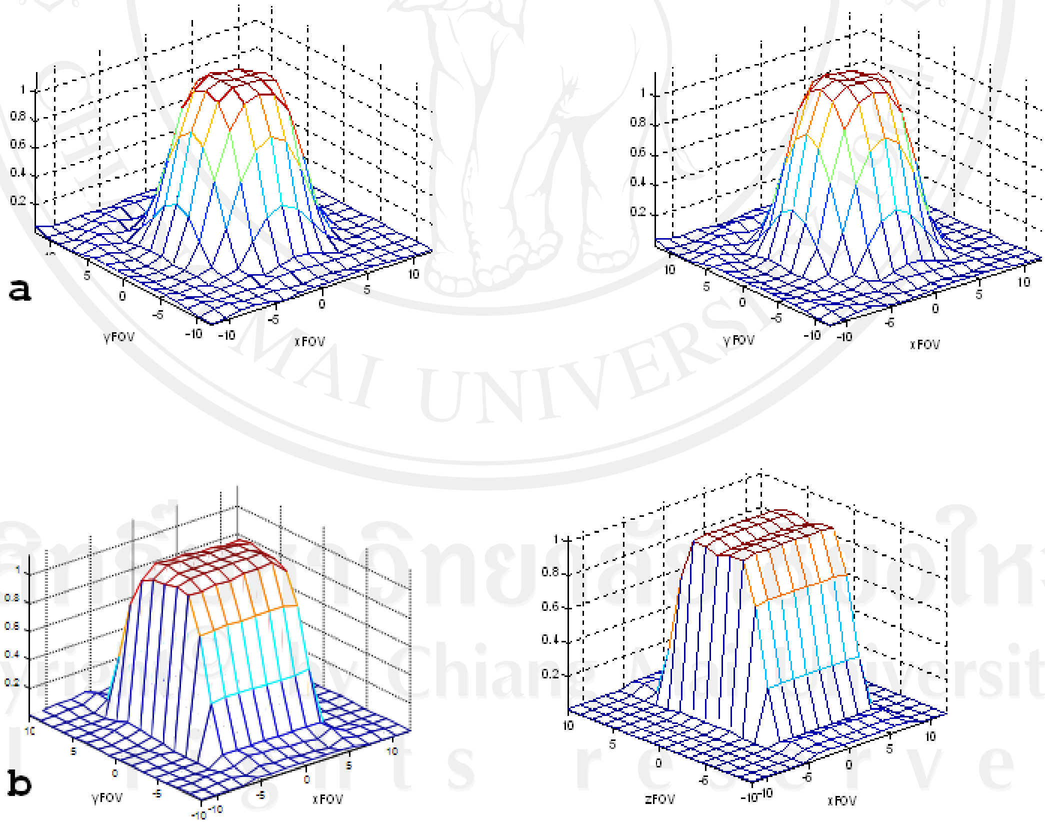

Figure 4.4 Mesh plot of numerical simulation (a, left) mesh plot in x-y plane, of the excitation using hybrid pulse and (a, right) conventional pulses. (b, left) Mesh plot in x-z plane of hybrid and (b, right) conventional 3D TRF pulses.

Figure 4.5 shows magnitude and phase of the desired selective 3D RF pulses compared with conventional selective 3D RF pulse. Figure 4.5 (a, top rows) shows the magnitude of one shot from a two-shot of the desired pulse given shorter pulse width than that of the conventional pulse shown in figure 4.5 (b), 13.8 ms./20.4 ms. respectively. The phase of desired pulse (fig 4.5 (a, second rows)) differs from that of the conventional pulse (fig 4.5 (b, last rows)) due to corrected shift of profile by alternating sign of imaginary part. The hybrid pulse shows approximately 34% shorter pulse width when compared with the conventional 3D TRF pulse.

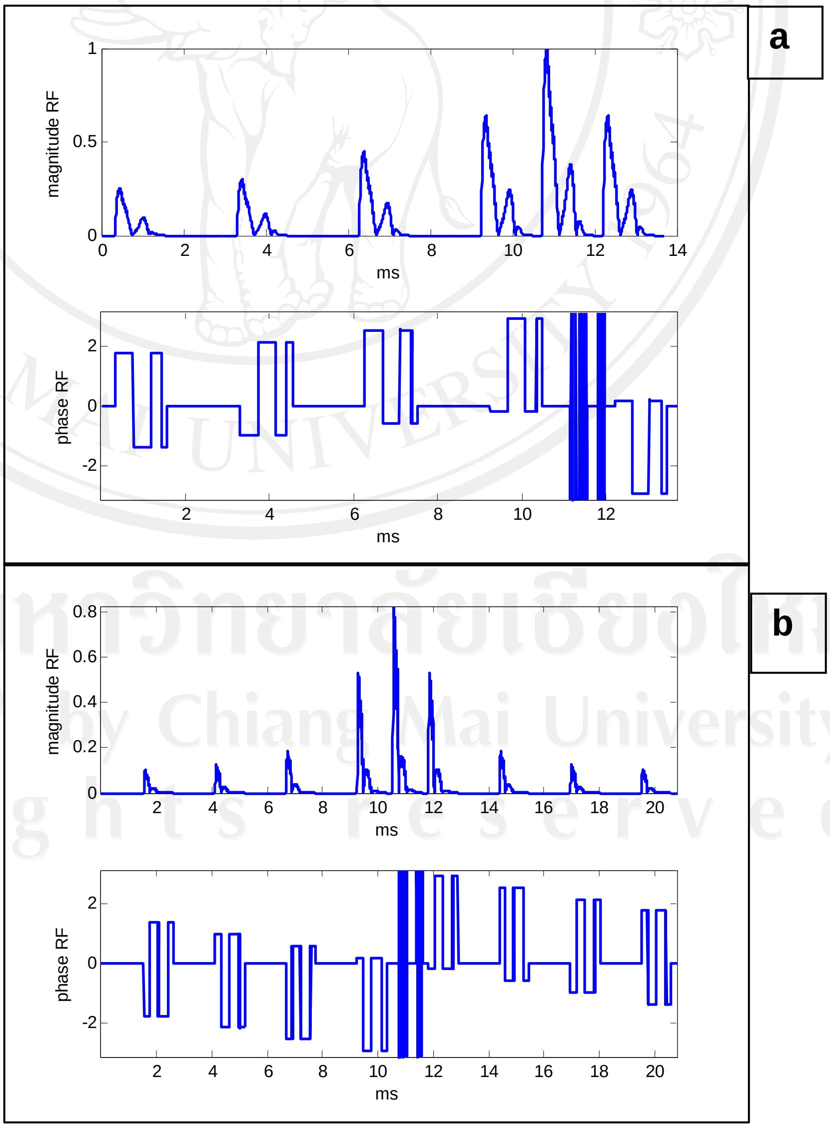

Figure 4.5 shows magnitude and phase of the desired selective 3D RF pulses (13.8 ms.), (a), compared with conventional selective 3D RF pulse (20.4 ms.) (b).

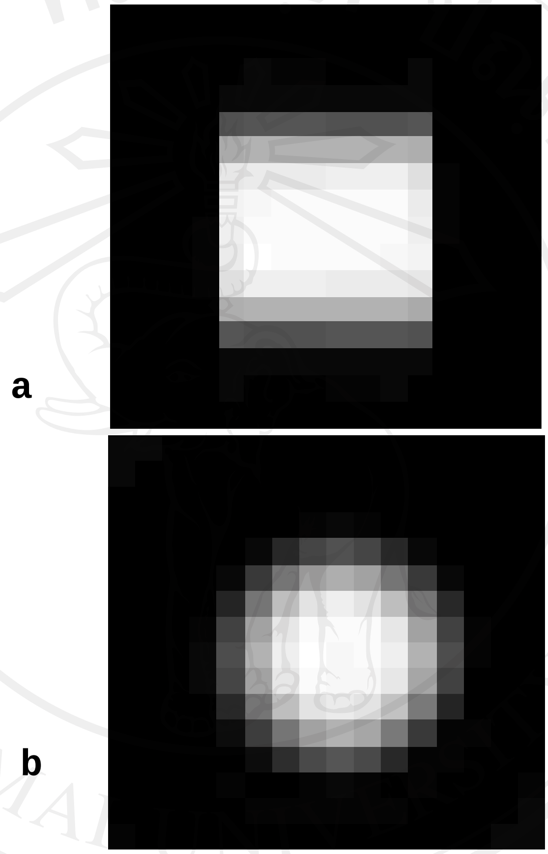

Figure 4.6 The Images from the simulation in x-z (a) and x-y plane (b).

Figure 4.6 shows numerical simulation images representing transverse magnetization obtaining from the hybrid pulse. Figure 4.7 shows the calculated images from numerical simulation of varying the excitation FOVs; x-y planes on the left, x-z planes on the middle and the profile in center of x planes on the right. In x-y plane, full (4/4) excitation FOV which is equivalent to object FOV of 24 cm for our design is shown on figure 4.7 (a), reduce excitation FOV to 3/4 or 18 cm. (b), reduce excitation FOV to 2/4 or 12 cm. (c) and reduce excitation FOV to 1/4 or 6 cm. (d). The optimum image was found in excitation FOV of 12 cm. as shown in fig 4.7 (c, right) when compared with full and three fourths excitation FOV show in fig 4.7 (a and b, right).

Even though, the quarter excitation FOV seem to be better but the profile along the x-y plane is not uniform as shown in fig 4.7 (d, right) when compared with the half excitation FOV in fig 4.7 (c, right).

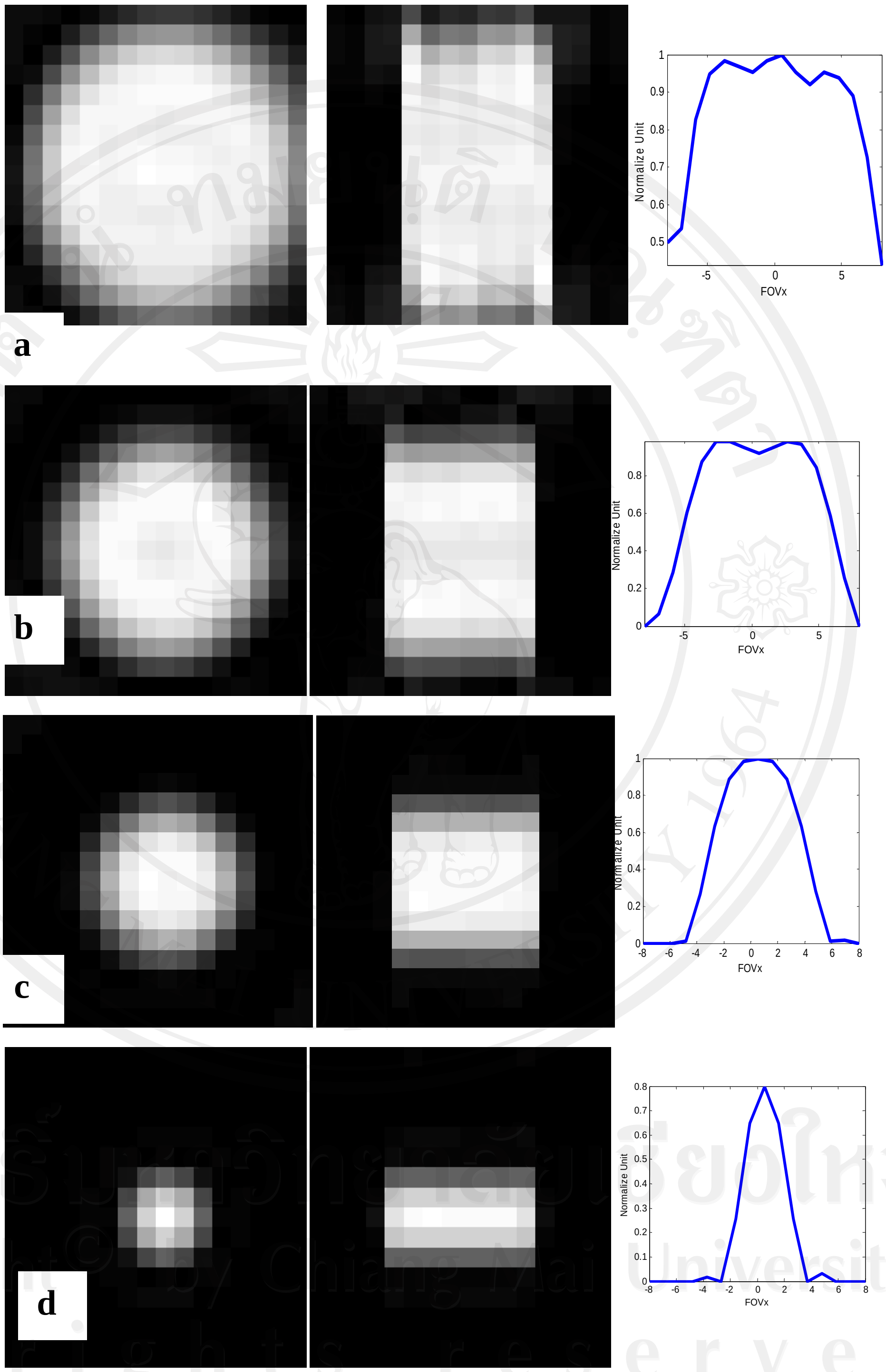

Figure 4.7 Varying excitation FOV in x-y plane, this figure show images from the simulation in x-y (left), x-z planes (middle) and the 1D profile along FOVx (right). In x-y plane, full (4/4) excitation FOV the same as FOV of object (a), reduce excitation FOV to 3/4 (b), reduce excitation FOV to 2/4 (c) and reduce excitation FOV to 1/4 (d).