## List of Figures

Figure 1.1. ICRU target volume definitions showing G	GTV, CTV, PTV, treated
and irradiated volume. Reproduced with permission	on from ICRU (1993)
Prescribing, Recording and Reporting Photon Beam Therapy. ICRU report 50	
(Barrett et al,	2007)
	6
Figure 1.28. ICRU illustrations to show (a) GTV-T pl	us GTV-N in continuity
(CTV-TN) and (b) CTV-T and CTV-N at a dist	ance. Reproduced with
permission from ICRU (2004) Prescribing, Recording	and Reporting Electron
Beam Therapy. ICRU report 71 (Barre	ett et al, 2007).
9	
Figure 2-1. Coronal views of CT scans of the same p	oatient taken during free
breathing (FB) (a) and with respiratory-gated scanning ea	xhale (b)16
Figure 2-2. Coronal views of CT scan of a static sphere (a) and a sinusoidally	
moving sphere (b) (2-cm range of motion and a 4-second period)17	
Figure 2-3. (a) During inhalation, the diaphragm contracts, the abdomen is forced	
down and forward, and the rib cage is lifted. (b) The intercostal muscles also	
contract to pull and rotate the ribs, resulting in increasing both the lateral and	
anterior–posterior (AP) diameters of the thorax	20
Figure 2-4. Variations in respiratory patterns form the	same patient taken a few
minutes apart. The three curves in each plot correspond	ond to infrared reflected
measured patient surface in the SI, AP, and ML directions, with each component	
arthitraity normalized. In (a) the motion pattern is relatively reproducible in	

shape, displacement magnitude, and pattern. In (b) the three trace is so irregular
that it is difficult to distinguish any respiratory pattern23
Figure 2-5. Tumor trajectories (not to scale) in 23 lung tumor patients, measured
using implanted markers and real-time stereoscopic fluoroscopy27
Figure 2-6. A schematic of the 4-D CT process using a ciné acquisition. Images
are acquired at each couch position for many respiratory phases31
Figure 2-7. Non-periodic patient breathing pattern (left) and image artifacts
introduced by phase binning (right)41
Figure 2-8. Comparison of external marker block motion with internal motion of
the clinical target volume (CTV) for a patient with (a) no phase shift and (b) a
patient with significant phase shift
Figure. 3-1. A graphic illustration of image registration process99
Figure. 3-2. Both (A) Inspiration and (B) Expiration images102
Figure. 3-3. Shows the Control point selection Tools
Figure. 3-8. showed the transformed image transparently overlaid on the base
image
Figure 4.1Shows mean and standard deviation of Respiratory Displacement109
Figure. 4-2. Showed the breathing wave (a) inspiration Phase, (b) expiration
phase and (c) Cross-correlation between inspiration and expiration phase111
Figure. 4-3. Showed the breathing wave (a) inspiration Phase, (b) expiration
phase and (c) Cross-correlation between inspiration and expiration phase113
Figure. 4-4. Showed the breathing wave (a) inspiration Phase, (b) expiration
phase and (c) Cross-correlation between inspiration and expiration phase115

