## Appendix

Let **t** be the vector defining the translation between the centres-of-mass of the two prostate glands under investigation. In addition, relying on this 3D rigid-body (translation alone) volume alignment, the centroids of the slice delineations were computed, by means of a slice-by-slice approach, according to the 'fixed' image space (rightmost part of Figure 1a). Afterwards, the slice delineations concerning the 'moving' volume were translated onto the 'fixed' image space so that the two centroids were coincident (Figure 1b). These slice-wise translations were stored in the $\mathbf{T}_S(i)$ data structure, for each slice $i \in \{1,2,\ldots,n\}$.

With regard to the prostate distortion evaluation, let $\mathbf{d}(i, \varphi)$ denote the local radial distortion vector for the current slice $i \in \{1,2,\ldots,n\}$ and the angle $\varphi$ by computing the $(x, y)$ radial vector from the 'moving' slice outline to the 'fixed' slice outline, evaluated at an interval $\delta\varphi$ in radial angle from the common centroid point. As a matter of fact, since the slice thickness was typically much higher than the in-plane pixel size, the local distortion was suitably assessed in cylindrical coordinates rather than in spherical coordinates.[20]

In our analysis, a subdivision into thirds (i.e., apex, mid-gland, and base) was considered by sequentially assigning $\lfloor N/3 \rfloor$ slices to each region when $\lfloor N/3 \rfloor \equiv 0(mod 3)$, where $\lfloor\cdot\rfloor$ is the floor operator. In the case of $\lfloor N/3 \rfloor \equiv 1(mod 3)$, the remaining slice is assigned to the mid-gland. In the case of $\lfloor N/3 \rfloor \equiv 2(mod 3)$, each of the two remaining slices is assigned to the mid-gland and base regions, respectively.

### *Prostate translocation*

Hereby, we considered the 'resultant translocation' $\mathbf{t}_{res}(i)$ as the vector addition of $\mathbf{t}_{2D}$ (denoting the $x$ and $y$ coordinates of the translation vector $\mathbf{t}$) and $\mathbf{T}_S$, so providing a measure of the global translocation of the prostate (see Figure 1c):

$$\boldsymbol{t}_{res}(i) = \boldsymbol{t} + \boldsymbol{T}_s(i), \forall i \in \{1,2,\ldots,n\}. \quad (1)$$

Aiming at achieving a comprehensive measurement of the total mean prostate gland translocation over the whole organ, the Root Mean Square (RMS) value of the magnitude of the resultant translocation vector $\mathbf{t}_{res}$ was calculated by averaging over all the $n$ slices according to Eq. (2):

$$t_{RMS} = \sqrt{\left[\sum_{i=1}^{n}\left(t_{res}(i)_x^2 + t_{res}(i)_y^2\right)\right]/n}. \qquad (2)$$

Along with the whole prostate gland, this calculation was performed also for the three thirds to highlight the different contributions in the three prostate regions.

### *Prostate distortion*

In order to better characterize the prostate distortion, the 'resultant distortion' $\mathbf{d}_{res}$(slice, $\varphi$) was computed from the slice-wise vector addition of $\mathbf{d}$ and $\mathbf{T}_S$, so gaining insights into the combined effects of translational and local distortions (Figure 1d):

$$\boldsymbol{d}_{res}(i,\varphi) = \boldsymbol{d}(i,\varphi) + \boldsymbol{T}_s(i),$$
$$\forall i \in \{1,2,\ldots,n\}, \varphi \in \{k \cdot \delta\varphi, with k = 0,1,\ldots,N | N \cdot \delta\varphi = 360°\}, \qquad (3)$$

where $n$ and $N$ are the number of the slices and the number of radial angle intervals $\delta\varphi$ (used in the cylindrical polar coordinate system), respectively. In our case, we considered unitary angle increments (i.e., $\delta = 1$ and $N = 360$).

In addition to the measurements taking into account all the radial angles, for better appreciating the distortions' directions in the axial section, a subdivision of the prostate (considering the axial plane) into four quadrants, namely: anterior, posterior, left, and right.

At the end of this process, we considered descriptive statistics to summarize the results. In particular, the mean and the 90th percentile (less affected by outliers than the maximum) were calculated over all the $n$ slices and the $N$ angle increments.