Conclusions: The performance of this innovative respiratory tracking device, that relies on abdominal height measurement, was then compared with the real-time position management (RPM) device, that relies on inhalation peaks, necessary for lung tumors, and can alter diagnosis. To account for motion effects, respiratory gating techniques have been developed. However, the lack of measures strongly correlated with tumor motion limits their accuracy. The authors developed a real-time pneumotachograph device (SPI) allowing to sort PET and CT images depending on lung volumes.

Methods: The performance of this innovative respiratory tracking system was characterized and compared to a standard system. Our experimental setup consisted in a movable platform and a thorax phantom with six fillable spheres simulating lung tumors. The accuracy of SPI to detect inhalation peaks was also determined on volunteers. A comparison with the real-time position management (RPM) device, that relies on abdominal height measurement, was then investigated.

Results: Experiments showed a high accuracy of the measured signal compared to the input signal ($R = 0.88$ to $0.99$), and of the detection of the inhalation peaks (error of $0.1 \pm 5.8$ ms) necessary for prospective binning mode. Activity recovery coefficient was improved (until $+39\%$) and the smearing effect was reduced (until $2.74$ times lower) with SPI compared to ungated PET/CT acquisition. The spatial distribution of activity in spheres was similar for 4D PET gated with SPI and RPM. Significant improvement of the binning stability and matching between PET and CT were highlighted for irregular breathing patterns with SPI.

Conclusions: SPI is an innovative device that provides better binning performance than the current gating device on phantom experiments. Future works will focus on patients where the authors expect a significant improvement of specificity and sensitivity of PET/CT examinations.

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A NEW RESPIRATORY GATING DEVICE TO IMPROVE 4D PET/CT
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Purpose: Respiratory motion creates artifacts in position emission tomography with computed tomography (PET/CT) images especially for lung tumors, and can alter diagnosis. To account for motion effects, respiratory gating techniques have been developed. However, the lack of measures strongly correlated with tumor motion limits their accuracy. The authors developed a real-time pneumotachograph device (SPI) allowing to sort PET and CT images depending on lung volumes.

Methods: The performance of this innovative respiratory tracking system was characterized and compared to a standard system. Our experimental setup consisted in a movable platform and a thorax phantom with six fillable spheres simulating lung tumors. The accuracy of SPI to detect inhalation peaks was also determined on volunteers. A comparison with the real-time position management (RPM) device, that relies on abdominal height measurement, was then investigated.

Results: Experiments showed a high accuracy of the measured signal compared to the input signal ($R = 0.88$ to $0.99$), and of the detection of the inhalation peaks (error of $0.1 \pm 5.8$ ms) necessary for prospective binning mode. Activity recovery coefficient was improved (until $+39\%$) and the smearing effect was reduced (until $2.74$ times lower) with SPI compared to ungated PET/CT acquisition. The spatial distribution of activity in spheres was similar for 4D PET gated with SPI and RPM. Significant improvement of the binning stability and matching between PET and CT were highlighted for irregular breathing patterns with SPI.

Conclusions: SPI is an innovative device that provides better binning performance than the current gating device on phantom experiments. Future works will focus on patients where the authors expect a significant improvement of specificity and sensitivity of PET/CT examinations.

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