3. Tongue Contour Extraction

- Boundary intensity map construction
  Gridlines are constructed around the central point of registered region and superimposed at a certain angle interval from the glottis to the glossodesmus. Then a boundary intensity map is constructed as following:
  a) the sectors between every two adjacent gridlines are labeled successively from the glottis to the glossodesmus.
  b) a boundary intensity map of $D \times N$ is built, where $D$ is the maximum distance from the tongue boundary points to the central point and $N$ is the total number of labeled sectors.
  c) along each arc of sectors, the maximum intensity of boundary points is selected as the map element.

- Searching for optimal boundary route
  A. Map modification with previous contour
  $M_{c} = K_{c} \times \exp(-\frac{(\xi_{j} - \xi_{j-1})^{2}}{\sigma_{M}^{2}})$
  B. Column transition probabilities
  $T_{c} = \exp(-\frac{X_{j} - Y_{j-1}}{\sigma_{T}^{2}})$
  C. Optimal boundary route
  $\mu = \arg \max_{\mu} P(M_{c}, \sigma_{c})$
  $\nu = \arg \max_{\nu} \prod_{n=1}^{N} \exp(-\frac{T_{c(n-\nu)} - T_{c(n+\nu-1)}}{\sigma_{T}^{2}})$
  D. Obtaining tongue contour using B-spline approximation [Yang, ICASSP 2013]

4. Experiments

In the figure below, images in the first row are results of the baseline method [Proctor, Interspeech 2010], and the second row are the proposed method. It demonstrates that the baseline method and the proposed method are both effective in most cases. However, the baseline method may extract the unreasonable tongue contour when tongue touches other organ boundaries. While the proposed method works well in this case, which shows improved robustness in more different situations.