ABSTRACT
The determination of the glottic source parameters is a relatively difficult subject, because it relates to the measurement of parameters convoluted of the vocal source. If, using a recording EGG, it is possible to reach two of the principal parameters of analysis, there is not currently reliable method to determine the remaining parameters. Thus, the models of speech production see their quality of synthesis often very compromised because of the difficult choice of the values of the source parameters. This work fits a little in the topic of determination of the parameters of the source. It consists in showing that an analysis of the variation of the formants of the spectrum of a synthesized signal (starting from an acoustic model of speech)) according to an unspecified parameter of the source, highlights the exact value of this parameter necessary to the production of the synthesized sound. This study also informs us about the impact of an unspecified parameter of the source about the spectral envelope of the vocal tract in simulation. The model of speech production used in this study is that of Klatt.

1-INTRODUCTION
The acoustic models of speech production are in general source-filter models. The source is built starting from elements depending on various variable parameters. The formants synthetizer of Klatt is a model source filters, of speech production based on the formants synthesis . The quality of the synthetic signal is related to the judicious choice of the parameters of the source which are very many and often very difficult to adjust. It is primarily made up of two distinct parts: sources and the vocal tract. In this study, we carried out two versions distinct from the Klatt synthetizer : one starting from the source model of Liljencrants-Fant (LF) [4] and another starting from the source model of Klatt[2 ].

2- Presentation and realization of the two sources used in the Klatt model
The Klatt model is overall made up of two distinct parts: sources (of voicing and friction) and the vocal tract (parallel structure for the production of fricative and the structure series for the production of the sounds nasalized, the vowels being able to be produced independently by one the other of the structures). The two sources used in the Klatt model in this studies are illustrated by figures 1 and 2. The source model of Klatt primarily consists of numerical resonators RGP, RGZ and RGS (figure1) the source model of Fant (LF) depends essentiellent quotients of opening Q0=(T1+T2)/T0 and Qd=T1/T2 dissymmetry (see figure 2)

3- methodology used
We produced a Klatt formants synthetizer using the software Matlab version 7.0. We synthesized the vowels /a /, /i/ and nasal /n/ after having regulated the source model parameters while taking as a starting point the the default values suggested by Guerin for the /a/ and Klatt for /a /, /i/ and nasal /n/. The parameters of study used for the Fant model are: the
the glottis opening quotient \( Q_0 \) and the dissymmetry quotient \( Q_d \). For the Klatt model of source, they are: those of resonator RGP: \((BGP, FGP)\); Those of resonator RGZ: \((BGZ, FGZ)\), Those of resonator RGS (\(BGS, FGS\)), and those of resonator RNZ (\(FNZ\) and \(BNZ\)) of the structure series of the synthétiseur[2] for the nasalized sounds. It is a question of varying one of these parameters by keeping the other constant ones. For the Klatt source model, the parameters are being very numerous, we have to make a small study based on listening in order to release a combination of these parameters necessary for obtaining a good synthesis. We thus defined combinations of parameters for each type of sound (vowel, occlusive, nasal liquidate etc). An example of combination of parameters for obtaining the vowels and nasal is represented by table 2. Table 3 gives the formants values of the phonémes used.

Table 3: phonémes used

<table>
<thead>
<tr>
<th>phonème</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
<th>F0</th>
</tr>
</thead>
<tbody>
<tr>
<td>/a/</td>
<td>740</td>
<td>1460</td>
<td>2700</td>
<td>3030</td>
<td>3900</td>
<td>200</td>
</tr>
<tr>
<td>/ə/</td>
<td>470</td>
<td>2460</td>
<td>3370</td>
<td>3800</td>
<td>4900</td>
<td>200</td>
</tr>
<tr>
<td>/ɑ/</td>
<td>270</td>
<td>1864</td>
<td>2943</td>
<td>4284</td>
<td>5730</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 2: combination of parameters for obtaining the vowels and nasal

<table>
<thead>
<tr>
<th>combinations of the parameters retained for the simulation of the vowels</th>
<th>combinations of the parameters retained for the simulation of the nasal ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av  Fgp Bgp Fgz Bgz Avz</td>
<td>Avz</td>
</tr>
<tr>
<td>60  0  500 2500 6000 60</td>
<td>60 20 0 500 2500 6000 60</td>
</tr>
<tr>
<td>Fgs Bgs Avs Af Fnp Bnp</td>
<td>Fgs Bgs Avs Af Fnp Bnp</td>
</tr>
<tr>
<td>0  500 60 -inf 270 90</td>
<td>0 500 60 -inf 270 90</td>
</tr>
<tr>
<td>Fnz Bnz Anp Anz Bf Fnz</td>
<td>Fnz Bnz Anp Anz Bf Fnz</td>
</tr>
<tr>
<td>270 90 0 0 50 270</td>
<td>270 90 0 0 50 270</td>
</tr>
</tbody>
</table>

In this study the excitation was carried out sometimes with the source model of Fant and sometimes with the Klatt source model of separately. We thus obtain two models of speech production. This study consists in finding by simulation of a spectral curve (spectrum of the synthesized signal), the known characteristics of a sound. It is then a question of extracting the values from formantic resonances. The technique used is based on the LPC (linear prediction). Model LPC is a model all poles autoregression (AR) where each pole corresponds to the characteristics of a formant i.e. its frequency, its amplitude and its band-width. We thus calculated these three parameters related to each formantic resonance of the spectrum of the synthesized signal.

4- RESULTS OBTAINED

The goal is to see which are the values of the parameters of the source which give the combination of the FI formants which approach more that introduced at the beginning for a quality of sound considered to be the best.

4-1- With the Liljencrants-Fant (LF) source model of glottic wave

The parameters used are the opening quotient \( Q_0 \) and the dissymmetry quotient \( Q_d \). we varies initially one of the coefficients \( Q_0 \) (or \( Q_d \)) while keeping the other constant one such as:

- by fixing an opening quotient \( Q_0 \) at 0.64 (0.64: value suggested by a study of Guerin [1] for the production from the /a/ and 0.37 for the production of the /i/) and while varying the dissymmetry quotient such as: \( 1.2 \leq Q_d \leq 2 \).

For the generation of the /a/:

- by fixing an opening quotient \( Q_0 \) at 0.64 (value suggested by Guerin [1] for the production of the /a/) and while varying the quotient of dissymmetry such as: \( 1.2 \leq Q_d \leq 2 \) (Lindqvist, 1970).
- by fixing \( Q_d \)=1.47 (value suggested by a study of Guerin for the /a/) and 0.3\( \leq Q_0 \leq 0.3 \) (Lindqvist, 1970).
According to figure 4 left, we note that starting from \(Q_d=1.47\) the values of the \(F_i\) formants are stabilized on the spectrum of the synthesized signal. The same remark can be made concerning the value of \(Q_0=0.64\). Let us note that the couple of values \(Q_d=1.47\) and \(Q_0=0.64\), is that selected to synthesize the vowel /a/. Let us note that the graphs of figure 4 present both of the particular values for the couple of values \(Q_d=1.47\) and \(Q_0=0.64\). We thus found the values of the parameters of the source which we chose beforehand to synthesize the /a/, for values of \(Q_d\) and \(Q_0\) corresponding to those fixed for obtaining a good quality of synthesis.

For the generation of the /i/ 
by fixing \(Q_0=0.4\) (value suggested by Guerin for the /i/) and \(1.2 \leq Q_d \leq 2\) 
by fixing \(Q_d=2\) (value suggested by Guerin for the /i/) and \(0.3 \leq Q_0 \leq 1\). Let us note that for the generation of the /i/, we chose the couple of value; \(Q_0=0.4\) and \(Q_d=2\). According to figure 5, we notice that this couple of points appears as a particular value on the graphs (this couple of points corresponds to frequencies of formants equal to those introduced into the synthesizer for the generation of the /i/). We thus make the same remark as for figure 4

4-2- 4-1- With the Klatt source model [2]
The study parameters used are: 
Those of resonator RGP : BGP, FGP; Those of resonator RGZ : BGZ, FGZ 
- Those of resonator RGS :FGS et BGS .

It is a question of varying one of these six parameters by keeping five the other constant ones.

With filter RGP: With the variation of parameter BGP: band-width of filter RGP
The value fixed before for obtaining a good quality of synthesis being of 500Hz. Let us see whether we can find it on the graph.
Figure 6 shows that the BGP=500Hz value seems a particular value of the graph for /a/ and /i/ (it is in fact the value that we retained for the generation of the two vowels and nasal the /n/). However, we notice that for /n/, the values of the formants chosen for the synthèse do not appear on the graph. Thus we can say, that /n/ is not sensitive to filter RGP.
Figure 6: Variation formants according to BGP for the three sounds /a/ /i/ and /n/.

Filter RGZ: variation of parameter BGZ: band-width of filter RGZ: value fixed before for obtaining a good quality of synthesis being of 6000Hz. can we find it on the graph.

Figure 7: Variation of the formants according to BGZ for the three sounds /a/ /i/ and /n/.

Here we notice that only the /a/ reacts to filter RGZ, and thus only with /a/ we manage to find the BGZ=6000Hz parameter of filter RGZ

With the variation of parameter FGZ: fréquence of filter RGZ
The value fixed before for obtaining a good quality of synthesis being of 1500Hz. let us see whether we can find it on the graph. According to figure 8, nasal /n/ is not sensitive to filter RGZ.
Let us note that the value of FGZ=1500Hz seems a particular value of the graph for /a/ and /i/. 

Figure 8: Variation of the formants according to FGZ for the two sounds /i/ and /n/.

For filter RGS: variation of parameter BGS: band-width of filter RGZ
The value fixed before for obtaining a good quality of synthesis being of 500Hz. let us see whether we can find it on the graph (see figure 9)
With the vowel /a/ we manage to locate on the graph the value of BGS=500Hz like a particular value, but it is not the case for nasal /n/, therefore it will be said that filter RGS does not influence much nasal /n/. After having noticed that for nasal /n/ the three filters of the voicing source did not influence formant resonances, we wanted to see with dimensions filter of nasalisation RNZ [2] being in the series part of the Klatt synthesizer.

**Results obtained with filter RNZ for nasal the /n/:** The values of the formants introduced into the Klatt synthesizer for the production of the /n/ are:

<table>
<thead>
<tr>
<th>FNZ=270</th>
<th>BNZ=90Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>phonème</td>
<td>F1</td>
</tr>
<tr>
<td>/n/</td>
<td>270</td>
</tr>
</tbody>
</table>

The but is to see which are the values of the parameters of the source which give the combination of the Fi formants which approach more that introduced at the beginning for a quality of sound considered to be the best. The figure 10 shows:

- For 10Hz≤FNZ≤200Hz, the all values of formants are different from the values of the formants introduced into the Klatt synthesizer at the beginning, that wants to say that the quality of sound is bad as long as 10Hz≤FNZ≤200Hz.
- From FNZ=270Hz (particular value of the graph corresponding to the value of FNZ introduced into the SAF to produce the /n/) we have a brutal passage of the formants to values equal to those introduced into the synthesizer for the production of /n/.
- For 10Hz≤BNZ≤150Hz, between 10Hz to 150Hz, the values all of formants are different from the values of the formants injected at the beginning, that wants to say that the quality of sound is bad as long as BNZ lies between 10 to 150Hz. Beyond 150 Hz, the formants take the values identical to those introduced into the synthesizer for the generation of /n/. However, the value of
BNZ=90Hz that we chose to generate the /n/ does not seem a particular value of the graph. Here it is the value of BNZ=200Hz which seems the particular value of the graph and moreover it is starting from this value that the formant take of the values identical to those introduced into the synthesizer for the production of /n/. Let us see that a checking of the quality of the sound obtained with listening sound with BNZ=200Hz confirmed that it is well the good value to be chosen for BNZ.

5- Conclusion
In this study, we synthesized the sounds /a/, /i/ and /n/ starting from two versions of the Klatt synthesizer, which we carried out. One with the source model of Fant, the other with the source model of Klatt. We have in the two cases found the parameters of the voicing source in the spectrum, by the means of the study of the formants variations of the spectrum of the signal synthesizes (radiated with the lips) according to the parameters of the source. This study showed that it is possible thus to find a parameter of source knowing the others.