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Apêndices

Ao longo desta pesquisa foram desenvolvidos programas na linguagem MatLab para processarem os dados obtidos durante as medições e gerarem informações para as análises estatísticas realizadas. Foram desenvolvidos três programas referentes às análises estatísticas realizadas, sendo eles:

1. Apêndice A: programa que gera as informações e os gráficos das análises de variabilidade do sinal realizadas;
2. Apêndice B: programa que gera as informações e gráficos de taxa de cruzamento de nível normalizada e tempo médio de desvanecimento normalizado;
3. Apêndice C: programa que gera as informações e gráficos da análise de correlação entre as subportadoras.

Apêndice A

```
% rotina que chama as funções “plotar_pilotos” e “plotar_pilotoRN”

abs_complex = abs(pilotoscomplex);
xlim_ = plotar_pilotos(abs_complex(:,1),abs_complex(:,2),
abs_complex(:,3),abs_complex(:,4),abs_complex(:,5),abs_complex(:,6),abs_com
plex(:,7),abs_complex(:,8));
   saveas(gcf,'CDF_pilotos.fig')
   saveas(gcf,'CDF_pilotos.jpeg')
figure
for i=1:8
   m(i) = mean(10*log10((abs_complex(:,i).^2)/50*1000));
   desv(i) = std(10*log10(abs_complex(:,i)));
   plotar_pilotoRN(abs_complex(:,i),xlim_,i)
   saveas(gcf,['Ray_Nakagami_piloto' num2str(i) '.fig'])
   saveas(gcf,['Ray_Nakagami_piloto' num2str(i) '.jpeg'])
end

m = m';
desv = desv';

save('medias.txt', 'm');
save('desvios_padrao.txt', 'desv');
```

% função “plotar_pilotos”

```
function xlim_ =
plotar_pilotos(arg_1,arg_2,arg_3,arg_4,arg_5,arg_6,arg_7,arg_8)

arg_1 = arg_1(:);
arg_2 = arg_2(:);
arg_3 = arg_3(:);
arg_4 = arg_4(:);
arg_5 = arg_5(:);
arg_6 = arg_6(:);
arg_7 = arg_7(:);
arg_8 = arg_8(:);

f_ = clf;
figure(f_);
set(f_,'Units','Pixels','Position',[1 61 800 500]);
legh_ = []; legt_ = {};
ax_ = newplot;
set(ax_,'Box','on');
hold on;

t_ = ~isnan(arg_1);
Data_ = arg_1(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
            );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0.333333 0 0.666667],'LineStyle','-', 'LineWidth',1);
```

```
grid on
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 1';

t_ = ~isnan(arg_2);
Data_ = arg_2(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
          );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0.333333 0.666667 0],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 2';

t_ = ~isnan(arg_3);
Data_ = arg_3(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
          );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0 0 0],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 3';

t_ = ~isnan(arg_4);
Data_ = arg_4(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
          );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0.333333 1 0.666667],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 4';

t_ = ~isnan(arg_5);
Data_ = arg_5(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
          );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0 0.333333 0.666667],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 5';

t_ = ~isnan(arg_6);
```

```
Data_ = arg_6(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
            );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0.666667 1 0.333333],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 6';

t_ = ~isnan(arg_7);
Data_ = arg_7(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
            );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0.333333 0.666667 1],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 7';

t_ = ~isnan(arg_8);
Data_ = arg_8(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
            );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color',[0 1 0],'LineStyle','-', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = 'CDF Dados Piloto 8';

xlim_ = get(ax_,'XLim');
if all(isfinite(xlim_))
   xlim_ = xlim_ + [-1 1] * 0.01 * diff(xlim_);
   set(ax_,'XLim',xlim_)
end

x_log = linspace(xlim_(1),xlim_(2),100);
x_ = ((10.^(x_log/10))*0.05).^(1/2);


hold off;
leginfo_ = {'Orientation', 'vertical', 'Location', 'NorthWest'};
h_ = legend(ax_,legh_,legt_,leginfo_{:});
set(h_,'Interpreter','none');
set(gcf,'Color',[1 1 1])
title('Função Distribuição Cumulativa das Sub-Portadoras Piloto')
```

% função “plotar_pilotoRN”

```
function plotar_pilotoRN(arg, xlim_, num_piloto)
```

```
arg = arg(:);
m = mean(10*log10((arg.^2)/50*1000));
desv = std(10*log10(arg));
f_ = clf;
figure(f_);
set(f_,'Units','Pixels','Position',[1 61 800 500]);
legh_ = []; legt_ = {};
ax_ = newplot;
set(ax_,'Box','on');
hold on;
t_ = ~isnan(arg);
Data_ = arg(t_);
[Y_,X_] = ecdf(Data_,'Function','cdf'...
            );
X_log = 10*log10((X_.^2)/50*1000);
h_ = stairs(X_log,Y_);
set(h_,'Color','k','LineStyle','none','Marker', 'o', 'LineWidth',1);
xlabel('Nivel de Sinal [dBm]');
ylabel('Probabilidade Cumulativa')
legh_(end+1) = h_;
legt_{end+1} = strvcat(['CDF dos Dados - Piloto ' num2str(num_piloto) ' (média =
' num2str(m) ' [dBm], desv. padrão = ' num2str(desv) ' [dB])']);


if all(isfinite(xlim_))
   xlim_ = xlim_ + [-1 1] * 0.01 * diff(xlim_);
   set(ax_,'XLim',xlim_)
end

x_log = linspace(xlim_(1),xlim_(2),100);
x_ = ((10.^(x_log/10))*0.05).^(1/2);

t_ = ~isnan(arg);
Data_ = arg(t_);

p_ = mle(Data_, 'dist','nakagami', 'alpha',0.05);
y_ = cdf('nakagami',x_,p_(1), p_(2));
h_ = plot(x_log,y_,'Color',[1 0 0],...
         'LineStyle','-', 'LineWidth',2.5,...
         'Marker','none', 'MarkerSize',6);
legh_(end+1) = h_;
legt_{end+1} = 'm-Nakagami';

t_ = ~isnan(arg);
Data_ = arg(t_);
p_ = raylfit(Data_, 0.05);
y_ = raylcdf(x_,p_(1));
h_ = plot(x_log,y_,'Color','b',...
         'LineStyle','--', 'LineWidth',1.5,...
         'Marker','none', 'MarkerSize',6);
legh_(end+1) = h_;
legt_{end+1} = 'Rayleigh';

hold off;
leginfo_ = {'Orientation', 'vertical', 'Location', 'NorthWest'};
```

```
h_ = legend(ax_,legh_,legt_,leginfo_{:});
set(h_,'Interpreter','none');
set(gcf,'Color',[1 1 1])
title(['Comparação da Função Distribuição Cumulativa da Subportadora Piloto '
num2str(num_piloto)])
```

Apêndice B

```
% rotina que calcula e gera os gráficos referentes à taxa de cruzamento de nível
normalizada e tempo médio de desvanecimento.
inicio1 = [40 65 90 115 141 166 191 216];

for jj = 1:length(inicio1)

   lim1 = min(PW_dBm(:,inicio1(jj)));
   lim2 = max(PW_dBm(:,inicio1(jj)));

   pontos = 60;

   rho_lin = zeros(pontos,1);
   taxa = zeros(pontos,1);
   tempo_desv = zeros(pontos,1);

% gera as informações dos dados medidos
   for ii = 1:pontos
      rho_lin(ii) = lim1 + (ii-1)*((lim2-lim1)/(pontos-1));
      temp = (PW_dBm(:,inicio1(jj)) < rho_lin(ii));
      taxa(ii) = sum(diff(temp) == 1);
      tempo_desv(ii) = sum(temp)/taxa(ii)*(217e-3/size(PW_dBm(:,:),1));
   end

   nivSinal = (abs(Y2256(:,inicio1(jj))));
   r_rms = sqrt(sum(nivSinal.^2)/size(nivSinal,1));

   R = sqrt((10.^(rho_lin./10))./20);
   rho = R./r_rms;
   rho_dB = 10.*log10(rho);

   v = 16.6; lambda = 3e8/3.410e9;
   fm = v/lambda;

   %% Reyleigh
   NR_ray = sqrt(2*pi).*rho.*exp(-rho.^2);
   AFD_ray = (1 - exp(-rho.^2))./NR_ray;
   %NR_ray_dB = 10*log10(NR_ray);

   %% m-Nakagami
   nivel = abs(Y2256(:,inicio1(jj)));
   m_nak = (mean(nivel.^2))^2/(var(nivel.^2));
   NR_nak = sqrt(2*pi)*((m_nak^(m_nak-0.5))/(gamma(m_nak))).*rho.^(2*m_nak-
1).*exp(-m_nak*rho.^2);
   AFD_nak = gammainc(m_nak.*(rho.^2),m_nak)./NR_nak;

   %% Plots
   figure(2*jj-1) % LCR
   NR = smooth(taxa(taxa>0)/fm/217e-3);
   subplot(1,2,1)
   semilogy(rho_dB(taxa>0),NR,'ko','LineWidth',1); hold on;
```

```
    semilogy(rho_dB,NR_ray,'b--','LineWidth',2.5);
    semilogy(rho_dB,NR_nak,'r','LineWidth',1.5);
    legend('Dados','Reyleigh',['m-Nakagami (m=' num2str(m_nak)
')'],'Location','South')
    axis1 = axis;
    axis([min(rho_dB(taxa>0)) max(rho_dB(taxa>0)) min(taxa(taxa>0)/fm)
max(max(NR_nak,2))]);
    axis([min(rho_dB(taxa>0)) max(rho_dB(taxa>0)) min(taxa(taxa>0)/fm) 2]);
    xlabel('\rho (dB)', 'FontSize', 12); ylabel('N_R/f_m', 'FontSize', 12);
    title('Taxa de Cruzamento de Nível Normalizada', 'FontSize', 12);
    set(gcf,'Color',[1 1 1]);
    set(gca, 'FontSize', 12);

    saveas(gcf,['lcr' num2str(jj) '.fig']);
    saveas(gcf,['lcr' num2str(jj) '.jpeg']);

    figure(2*jj) % AFD
    TR = smooth(tempo_desv*fm);
    subplot(1,2,2)
    semilogy(rho_dB,TR,'ko','LineWidth',1); hold on;
    semilogy(rho_dB,AFD_ray,'b--','LineWidth',2.5);
    semilogy(rho_dB,AFD_nak,'r','LineWidth',1.5);
    legend('Dados','Reyleigh',['m-Nakagami (m=' num2str(m_nak)
')'],'Location','NorthWest')
    axis1 = axis;
   axis([min(rho_dB(tempo_desv>0)) max(rho_dB(tempo_desv>0))
min(tempo_desv(tempo_desv>0)*fm)
max(max(tempo_desv(tempo_desv>0),2))]); %2 no último lugar
    axis([min(rho_dB(tempo_desv>0)) max(rho_dB(tempo_desv>0)) axis1(3)
axis1(4)]);
    xlabel('\rho (dB)', 'FontSize', 12); ylabel('T_Rf_m', 'FontSize', 12);
    title('Tempo Médio de Desvanecimento Normalizado', 'FontSize', 12);
    set(gcf,'Color',[1 1 1]);
    set(gca, 'FontSize', 12);

    saveas(gcf,['lcr_afd' num2str(jj) '.fig']);
    saveas(gcf,['lcr_afd' num2str(jj) '.bmp']);

    save(['m_nak' num2str(jj) '.txt'], 'm_nak','-ascii','-double');


end
```

Apêndice C

```
%rotina que gera as informações e gráficos da análise de banda de coerência

inicio1 = 40;
inicio2 = 65;
inicio3 = 90;
inicio4 = 115;
inicio5 = 141;
inicio6 = 166;
inicio7 = 191;
inicio8 = 216;
tamanho1 = 229-inicio1;
tamanho2 = 229-inicio2;
tamanho3 = 229-inicio3;
tamanho4 = 229-inicio4;
tamanho5 = 229-inicio5;
tamanho6 = 229-inicio6;
tamanho7 = 229-inicio7;
tamanho8 = 229-inicio8;

abs_y2256 = abs(Y2256);

for i = 1:tamanho1
   r11(i)=corr((abs_y2256(:,inicio1)),abs_y2256(:,i-1+inicio1));
end
for i = 1:tamanho2
   r2(i)=corr((abs_y2256(:,inicio2)),abs_y2256(:,i-1+inicio2));
end
for i = 1:tamanho3
   r3(i)=corr((abs_y2256(:,inicio3)),abs_y2256(:,i-1+inicio3));
end
for i = 1:tamanho4
   r4(i)=corr((abs_y2256(:,inicio4)),abs_y2256(:,i-1+inicio4));
end
for i = 1:tamanho5
   r5(i)=corr((abs_y2256(:,inicio5)),abs_y2256(:,i-1+inicio5));
end
for i = 1:tamanho6
   r6(i)=corr((abs_y2256(:,inicio6)),abs_y2256(:,i-1+inicio6));
end
for i = 1:tamanho7
   r7(i)=corr((abs_y2256(:,inicio7)),abs_y2256(:,i-1+inicio7));
end
for i = 1:tamanho8
   r8(i)=corr((abs_y2256(:,inicio8)),abs_y2256(:,i-1+inicio8));
end

r11 = smooth(r11);
r2 = smooth(r2);
r3 = smooth(r3);
r4 = smooth(r4);
r5 = smooth(r5);
r6 = smooth(r6);
r7 = smooth(r7);
```

```
r8 = smooth(r8);

%% Plot inicio_1
plot(inicio1:inicio1+tamanho1-1,abs(r11),'*k--','LineWidth',1.0)
axis([inicio1 inicio1+tamanho1-1 0 1])
set(gca,'XTick',inicio1:10:inicio1+tamanho1-1,'YTick',[-1:0.1:1],...
   'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio1)], ...
   'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r11<0.5,1)-1+(inicio1-1):find(r11<0.5,1)+(inicio1-1),
r11(find(r11<0.5,1)-1:find(r11<0.5,1)));
largura1 = (largura - inicio1) * 16.276041;
DelaySpread_inicio1 = 1 / (5 * largura1 * 1000);
BC_inicio1 = largura1 * 1000;

hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.8,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')
saveas(gcf,'corr_inicio1.fig')
saveas(gcf,'corr_inicio1.jpeg')

figure

%% Plot inicio_2
plot(inicio2:inicio2+tamanho2-1,abs(r2),'*k--','LineWidth',1.0)
axis([inicio2 inicio2+tamanho2-1 0 1])
set(gca,'XTick',inicio2:10:inicio2+tamanho2-1,'YTick',[-1:0.1:1],...
   'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on

title(['Correlação da subportadora ' num2str(inicio2) ], ...
   'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r2<0.5,1)-1+(inicio2-1):find(r2<0.5,1)+(inicio2-1),
r2(find(r2<0.5,1)-1:find(r2<0.5,1)));
largura1 = (largura - inicio2) * 16.276041;
DelaySpread_inicio2 = 1 / (5 * largura1 * 1000);
BC_inicio2 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')
```

```
saveas(gcf,'corr_inicio2.fig')
saveas(gcf,'corr_inicio2.jpeg')

figure

%% Plot inicio_3
plot(inicio3:inicio3+tamanho3-1,abs(r3),'*k--','LineWidth',1.0)
axis([inicio3 inicio3+tamanho3-1 0 1])
set(gca,'XTick',inicio3:10:inicio3+tamanho3-1,'YTick',[-1:0.1:1],...
   'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio3)], ...
   'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r3<0.5,1)-1+(inicio3-1):find(r3<0.5,1)+(inicio3-1),
r3(find(r3<0.5,1)-1:find(r3<0.5,1)));
largura1 = (largura - inicio3) * 16.276041;
DelaySpread_inicio3 = 1 / (5 * largura1 * 1000);
BC_inicio3 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio3.fig')
saveas(gcf,'corr_inicio3.jpeg')

figure

%% Plot inicio_4
plot(inicio4:inicio4+tamanho4-1,abs(r4),'*k--','LineWidth',1.0)
axis([inicio4 inicio4+tamanho4-1 0 1])
set(gca,'XTick',inicio4:10:inicio4+tamanho4-1,'YTick',[-1:0.1:1],...
   'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio4) ], ...
   'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r4<0.5,1)-1+(inicio4-1):find(r4<0.5,1)+(inicio4-1),
r4(find(r4<0.5,1)-1:find(r4<0.5,1)));
largura1 = (largura - inicio4) * 16.276041;
DelaySpread_inicio4 = 1 / (5 * largura1 * 1000);
BC_inicio4 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
```

```
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio4.fig')
saveas(gcf,'corr_inicio4.jpeg')

figure

%% Plot inicio_5
plot(inicio5:inicio5+tamanho5-1,abs(r5),'*k--','LineWidth',1.0)
axis([inicio5 inicio5+tamanho5-1 0 1])
set(gca,'XTick',inicio5:10:inicio5+tamanho5-1,'YTick',[-1:0.1:1],...
    'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio5) ], ...
    'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r5<0.5,1)-1+(inicio5-1):find(r5<0.5,1)+(inicio5-1),
r5(find(r5<0.5,1)-1:find(r5<0.5,1)));
largura1 = (largura - inicio5) * 16.276041;
DelaySpread_inicio5 = 1 / (5 * largura1 * 1000);
BC_inicio5 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio5.fig')
saveas(gcf,'corr_inicio5.jpeg')

figure

%% Plot inicio_6
plot(inicio6:inicio6+tamanho6-1,abs(r6),'*k--','LineWidth',1.0)
axis([inicio6 inicio6+tamanho6-1 0 1])
set(gca,'XTick',inicio6:10:inicio6+tamanho6-1,'YTick',[-1:0.1:1],...
    'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio6) ], ...
    'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r6<0.5,1)-1+(inicio6-1):find(r6<0.5,1)+(inicio6-1),
r6(find(r6<0.5,1)-1:find(r6<0.5,1)));
largura1 = (largura - inicio6) * 16.276041;
DelaySpread_inicio6 = 1 / (5 * largura1 * 1000);
BC_inicio6 = largura1 * 1000;
```

```
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio6.fig')
saveas(gcf,'corr_inicio6.jpeg')

figure

%% Plot inicio_7
plot(inicio7:inicio7+tamanho7-1,abs(r7),'*k--','LineWidth',1.0)
axis([inicio7 inicio7+tamanho7-1 0 1])
set(gca,'XTick',inicio7:10:inicio7+tamanho7-1,'YTick',[-1:0.1:1],...
    'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio7) ], ...
    'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r7<0.5,1)-1+(inicio7-1):find(r7<0.5,1)+(inicio7-1),
r7(find(r7<0.5,1)-1:find(r7<0.5,1)));
largura1 = (largura - inicio7) * 16.276041;
DelaySpread_inicio7 = 1 / (5 * largura1 * 1000);
BC_inicio7 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio7.fig')
saveas(gcf,'corr_inicio7.jpeg')

figure

%% Plot inicio_8
plot(inicio8:inicio8+tamanho8-1,abs(r8),'*k--','LineWidth',1.0)
axis([inicio8 inicio8+tamanho8-1 0 1])
set(gca,'XTick',inicio8:2:inicio8+tamanho8-1,'YTick',[-1:0.1:1],...
    'FontSize', 11)
set(gcf,'Color',[1 1 1])
grid on
title(['Correlação da subportadora ' num2str(inicio8) ], ...
    'fontsize',12,'fontweight','b');
xlabel('Subportadoras','fontsize',12,'fontweight','b')
ylabel('Correlação','fontsize',12,'fontweight','b')

largura = bandaCorr(find(r8<0.5,1)-1+(inicio8-1):find(r8<0.5,1)+(inicio8-1),
r8(find(r8<0.5,1)-1:find(r8<0.5,1)));
```

```
largura1 = (largura - inicio8) * 16.276041;
DelaySpread_inicio8 = 1 / (5 * largura1 * 1000);
BC_inicio8 = largura1 * 1000;
hold on
line([largura largura],[-1 0.5],'Color','k','LineWidth',2)
line([0 largura],[0.5 0.5],'Color','k','LineWidth',2)
plot(largura,0.5,'k.','MarkerSize',20)
text(largura+1,0.6,['BC_{50%}=' num2str(largura1) '
KHz'],'BackgroundColor','w','EdgeColor','k')

saveas(gcf,'corr_inicio8.fig')
saveas(gcf,'corr_inicio8.jpeg')

%% Matriz de banda de coerência e Delay Spread
BC_DelaySpread = [BC_inicio1 DelaySpread_inicio1 ; BC_inicio2
DelaySpread_inicio2; BC_inicio3 DelaySpread_inicio3 ; ...
        BC_inicio4 DelaySpread_inicio4; BC_inicio5 DelaySpread_inicio5 ;
BC_inicio6 DelaySpread_inicio6; ...
        BC_inicio7 DelaySpread_inicio7 ; BC_inicio8 DelaySpread_inicio8];
save('BC_DelaySpread.txt','BC_DelaySpread','-ascii','-double');
```