

Summer research program

Machine Tool Monitoring

By
Dongwei Bai

Introduction about myself

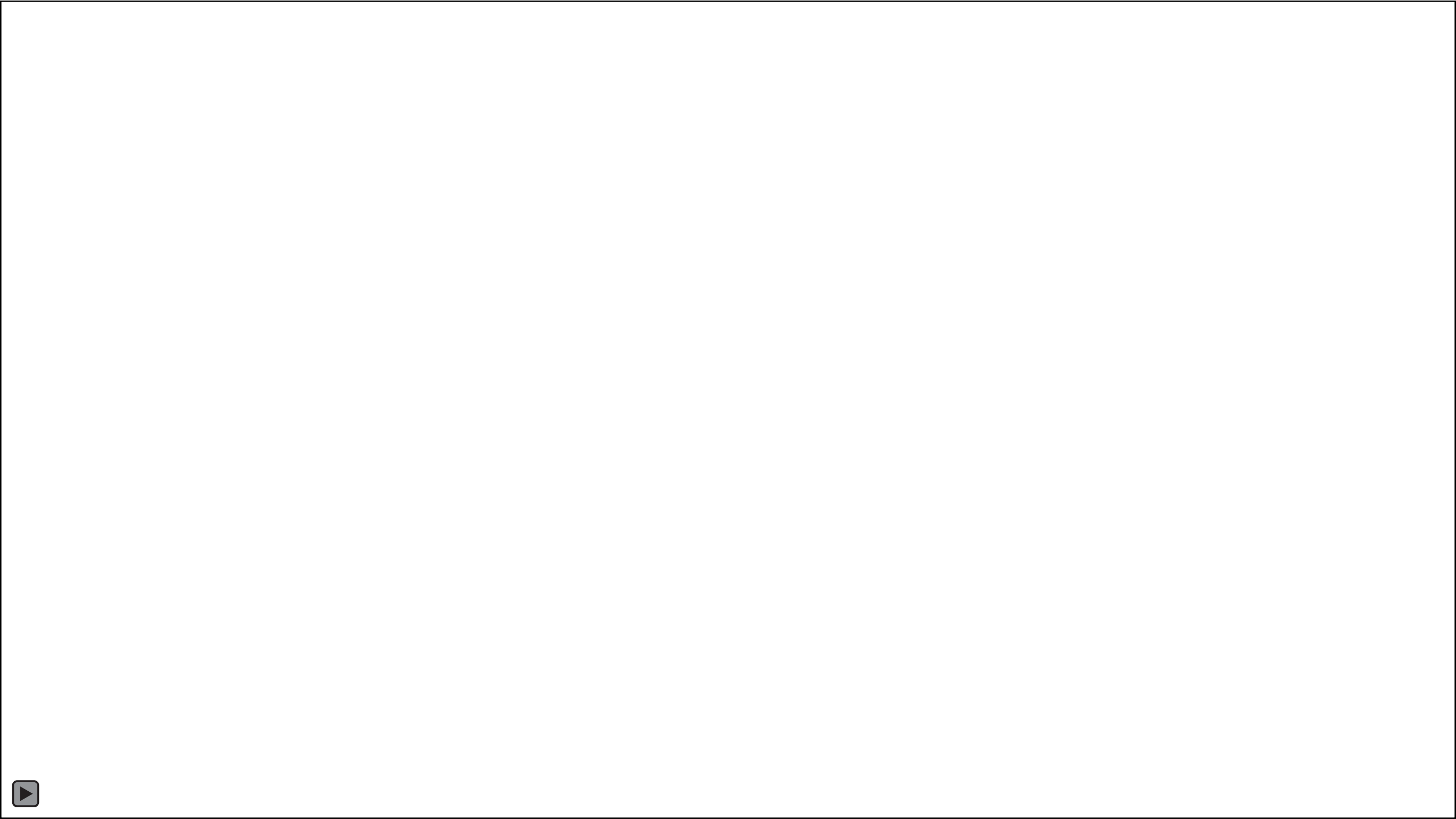
- ❖ Name: Dongwei Bai
- ❖ School: Purdue University
- ❖ Major: Mechanical Engineering
- ❖ Nationality: Chinese
- ❖ Current research: Institut für Fertigungstechnik und Werkzeugmaschinen (IFW)

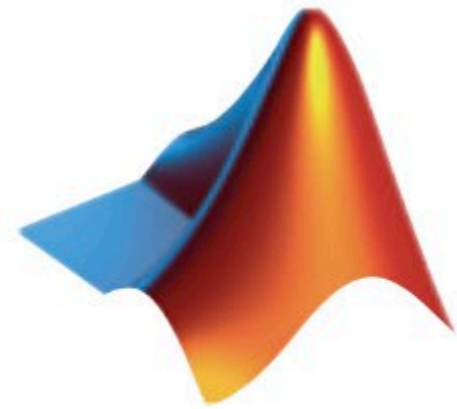


My Advisor

- ❖ Name: Tobias Stiehl
- ❖ School: Leibniz Universität
- ❖ Major: Mechanical Engineering
- ❖ Research topics: Tool condition monitoring





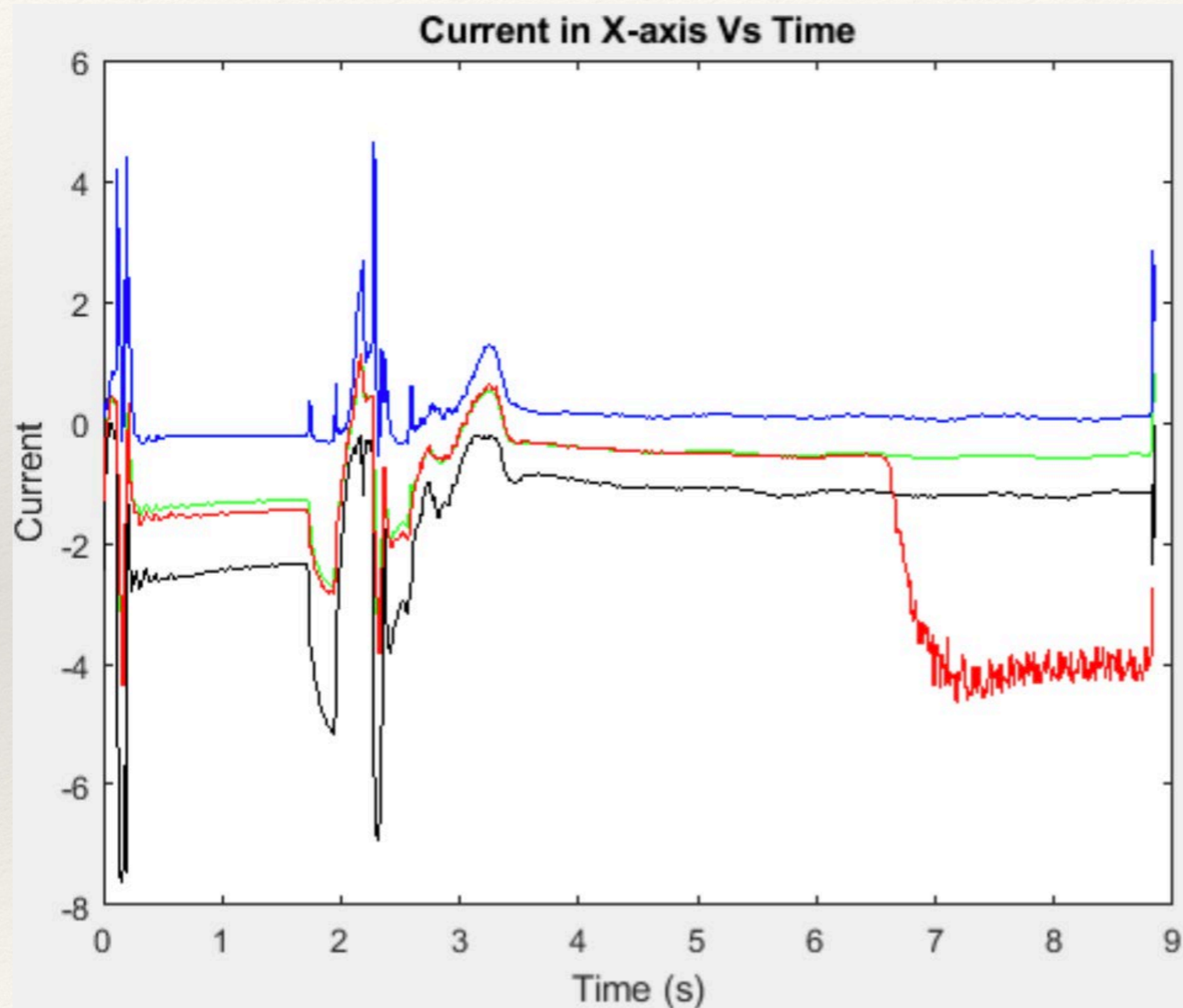
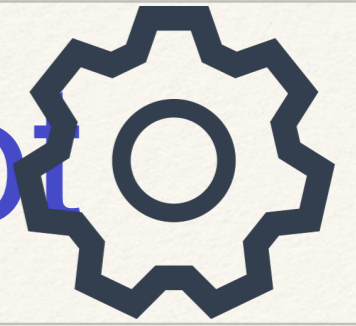


MathWorks®

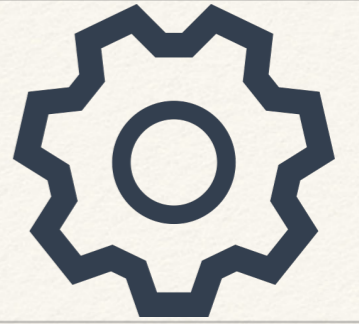
Core program

MATLAB

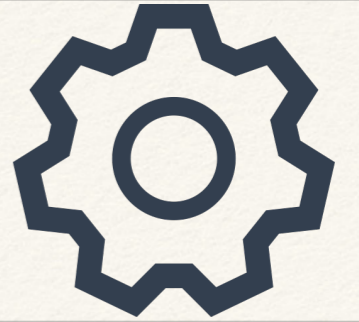
Process showing in plot



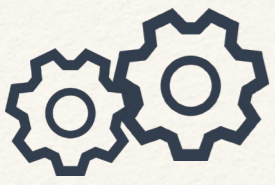
Processes



Processes



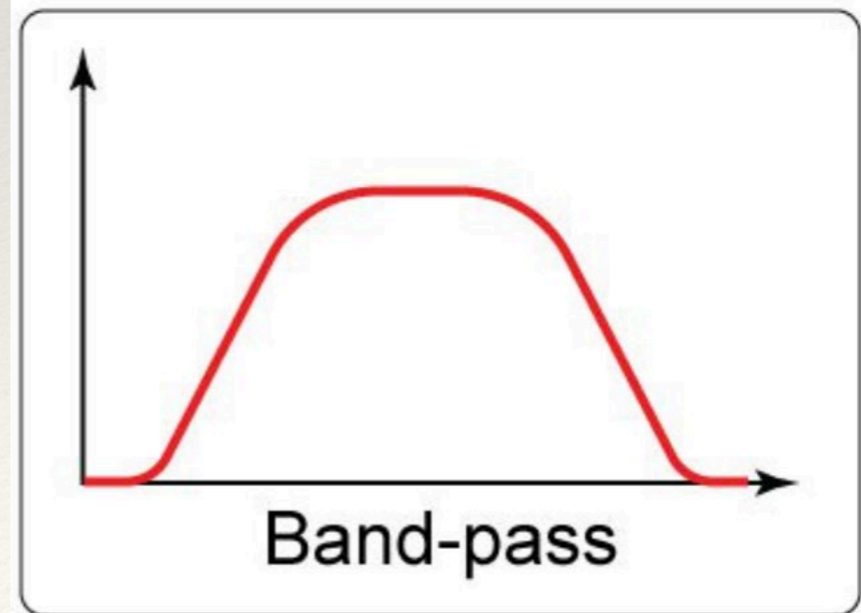
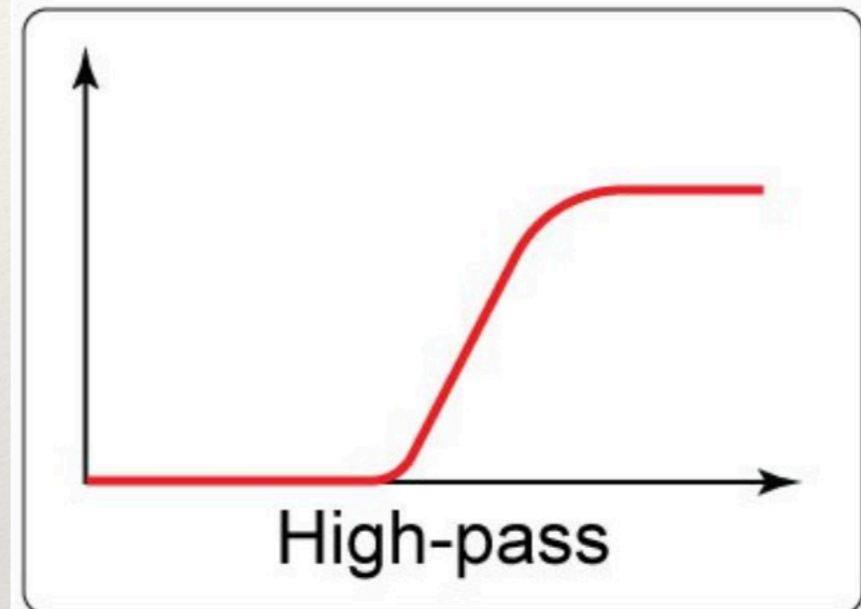
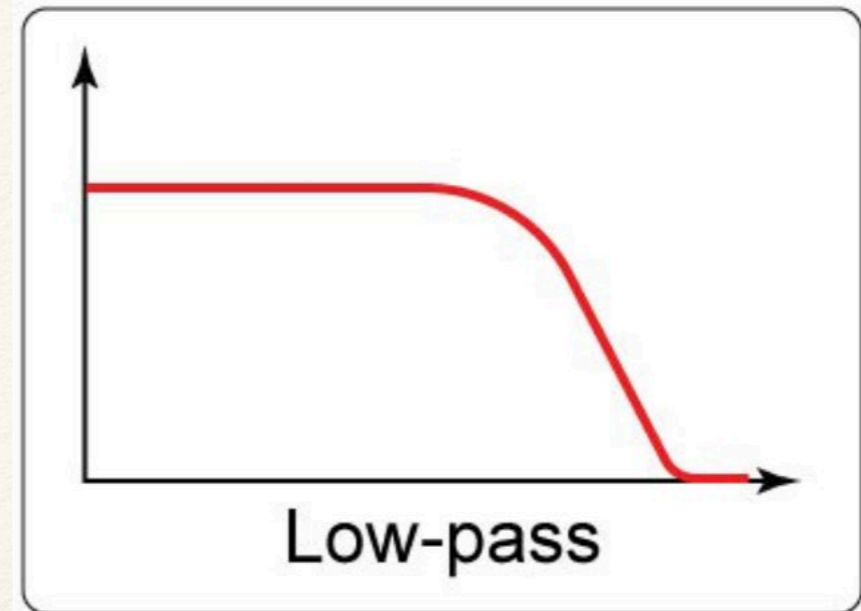
- ❖ Filter the data
- ❖ Calculate the limits, average, etc
- ❖ Algorithm to get output data
- ❖ Understand the output



- ❖ Filter the data

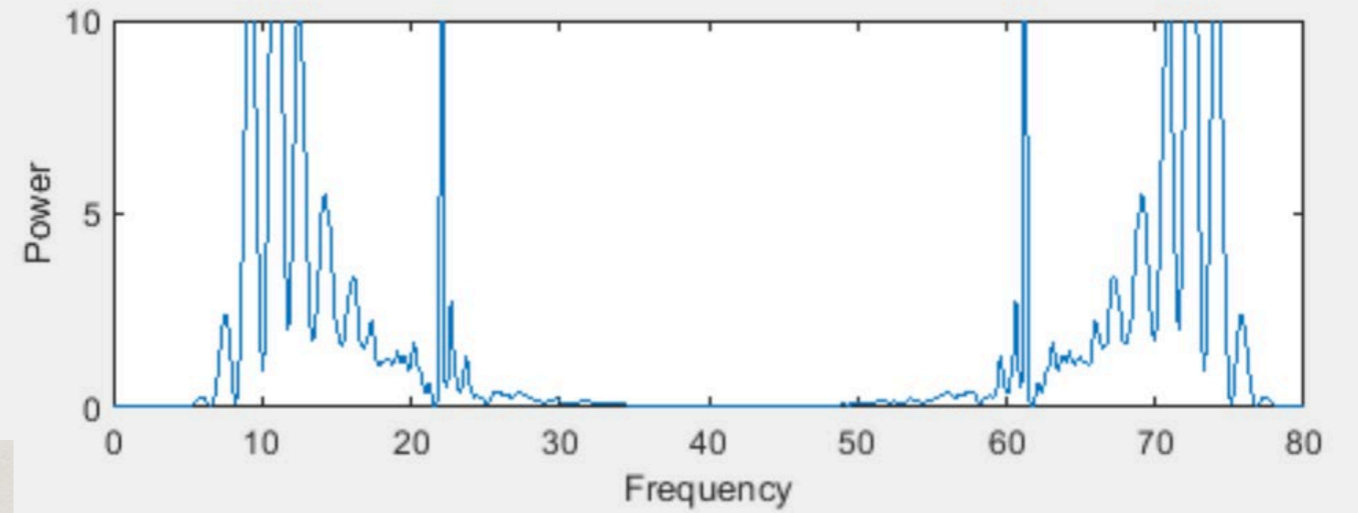
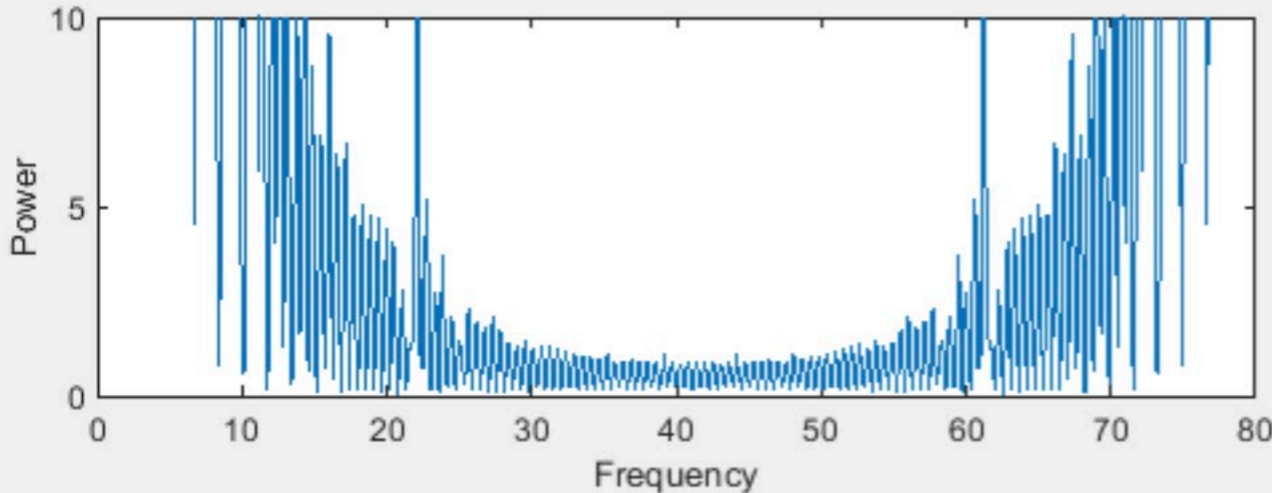
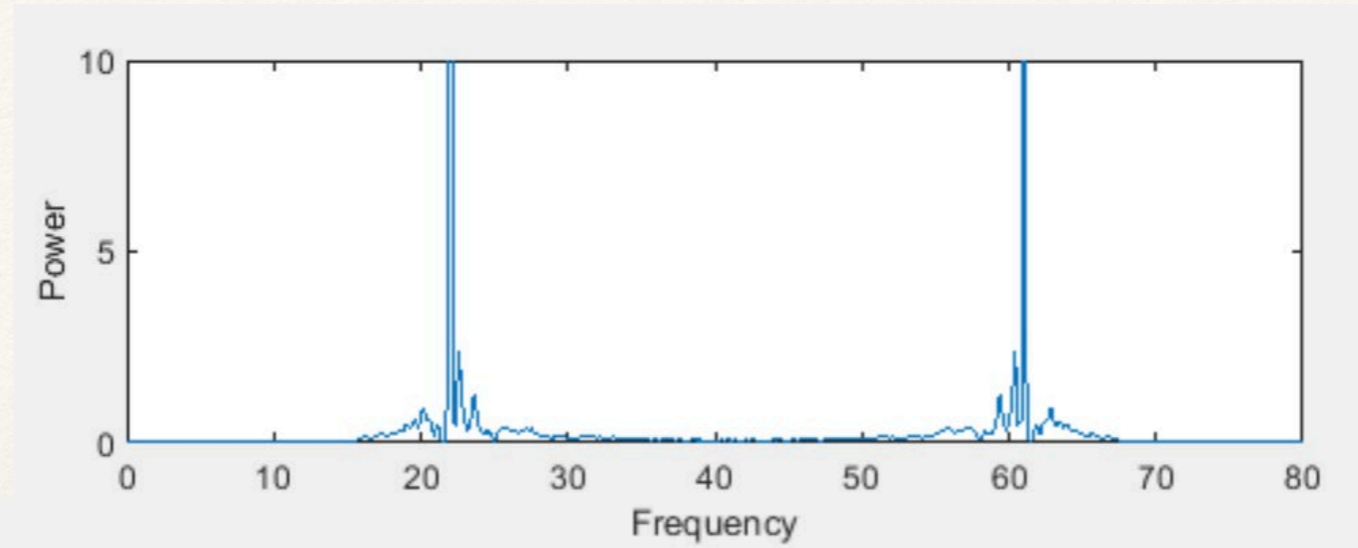
Filter Design

Use of different filters to pass signals required and block signals that don't need



Fourier transform

Low-pass filter

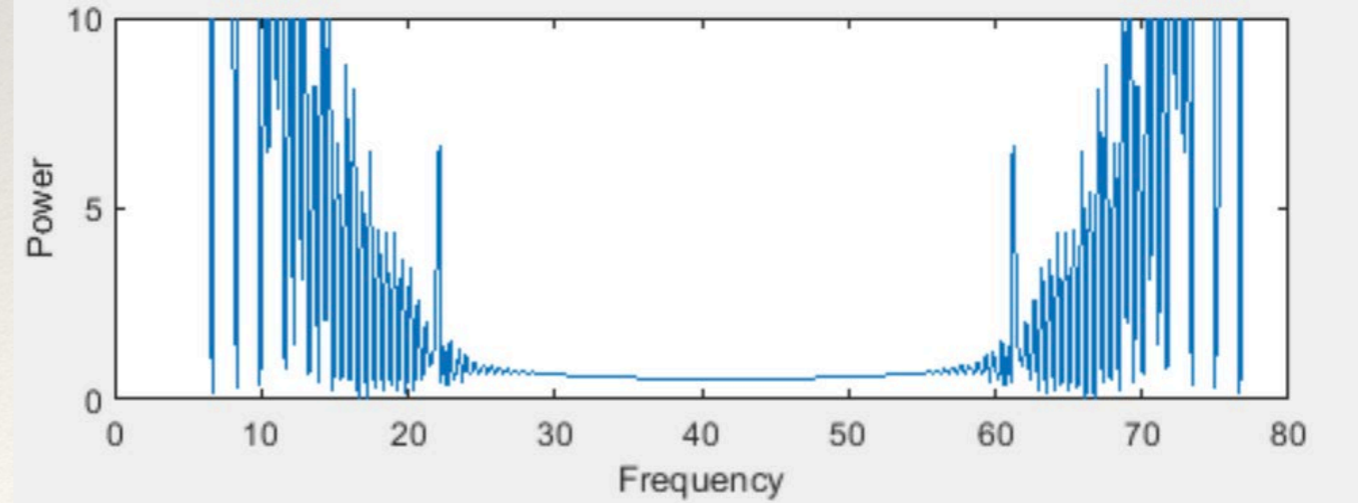


Torque main spindle

High-pass filter



Band-pass filter



Algorithmic



```
%% CALCULATION
Maxval = movmax(data_filtered,windowsize,'endpoint','fill'); %Max value of data
Minval = movmin(data_filtered,windowsize,'endpoint','fill'); %Min value of data
Meanval = movmean(data_filtered,windowsize,'endpoint','fill'); %Mean value of data
Medianval = movmedian(data_filtered,windowsize,'endpoint','fill'); %Median value of data
stdval = movstd(data_filtered,windowsize,'endpoint','fill'); %Standard deviation

%% PLOT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%EXTREME VAULE%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
plot(tvec,data_filtered,'--',tvec,Maxval,'-');
hold on
plot(tvec,data_filtered,'--',tvec,Minval,'. ');
legend('Original data','Moving max value','Moving min value');
grid on;
xlabel('Time (s)');
ylabel('Amplitude');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%MEAN VALUE%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
plot(tvec,data_filtered,'--',tvec,Meanval,'-');
legend('Original data','Moving mean value');
grid on;
xlabel('Time (s)');
```

Decision Making

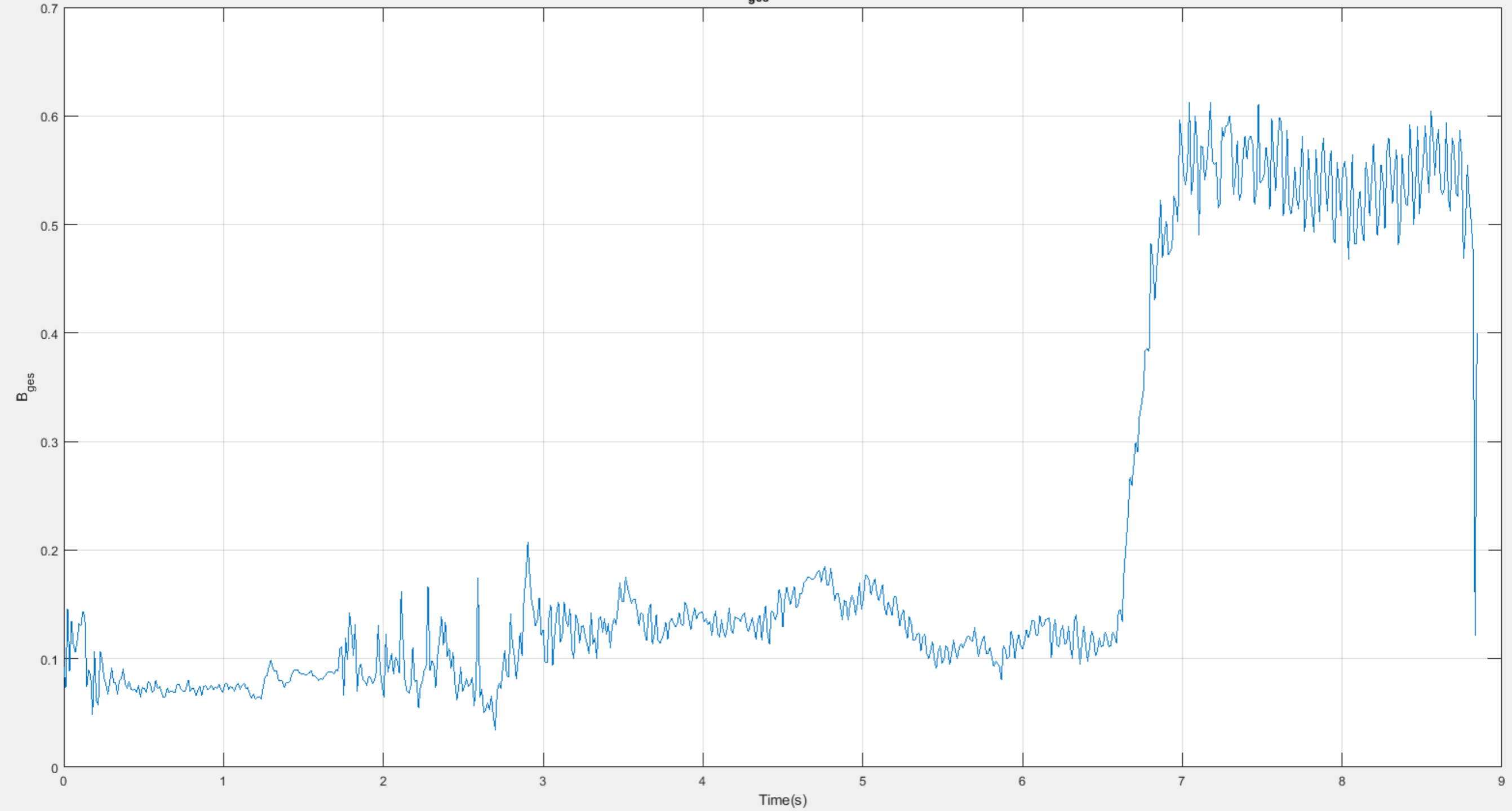


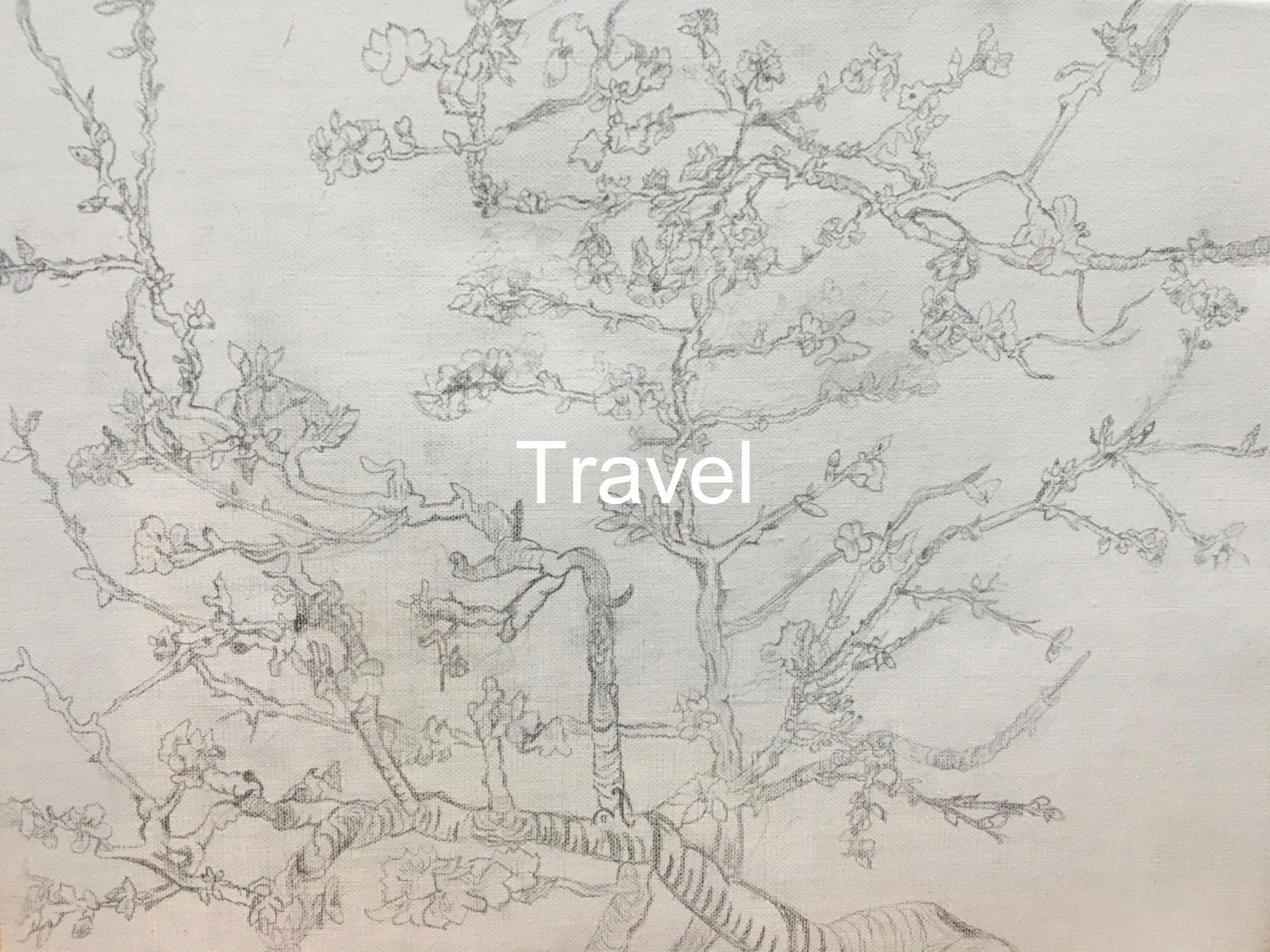
- ❖ S_k : Standard deviation of values at the respective time
- ❖ B_k : Rating of single feature K
- ❖ B_{ges} : Total valuation by combining each individual valuation



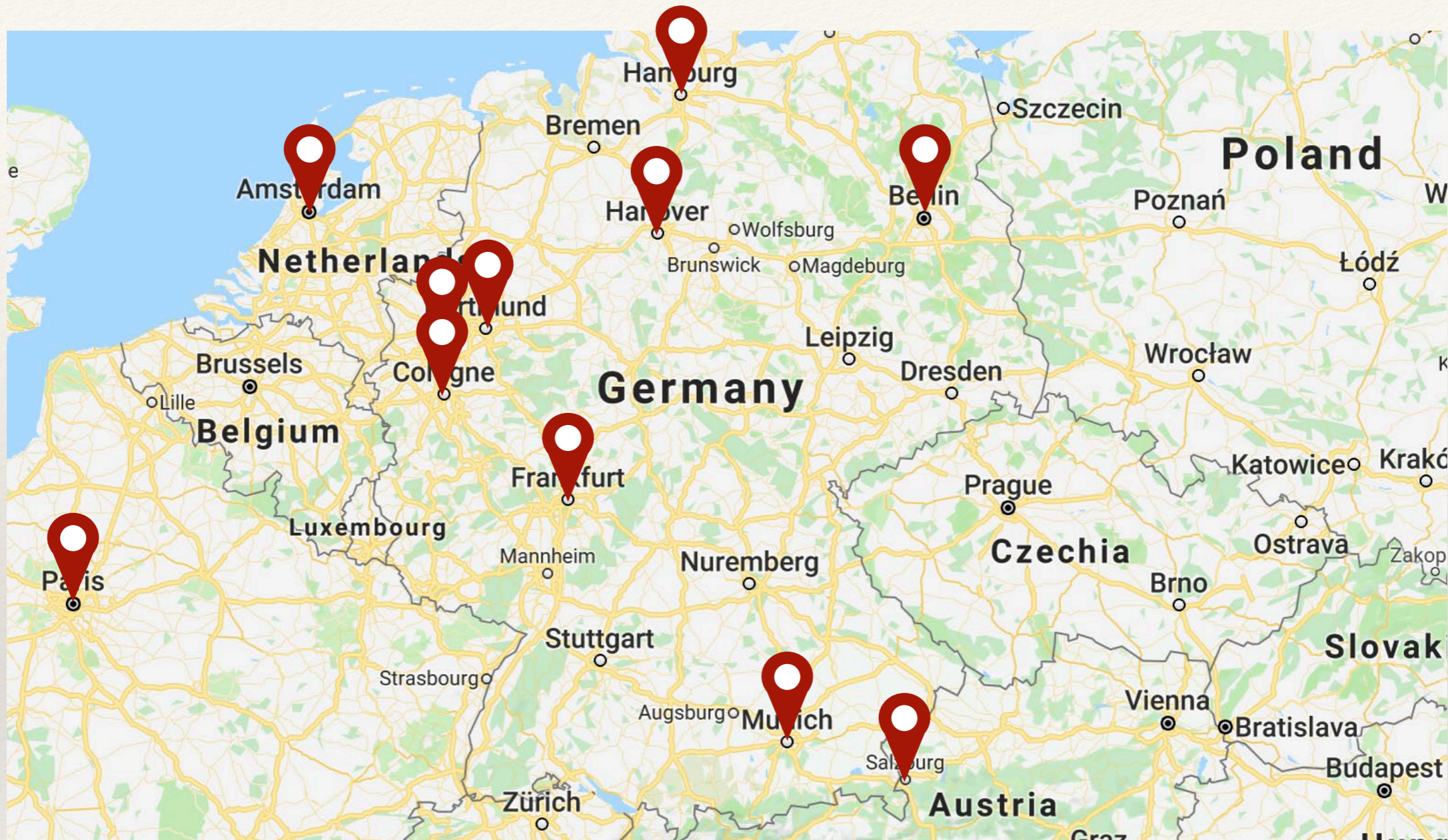
Output Data

B_{ges} Vs Time





Travel

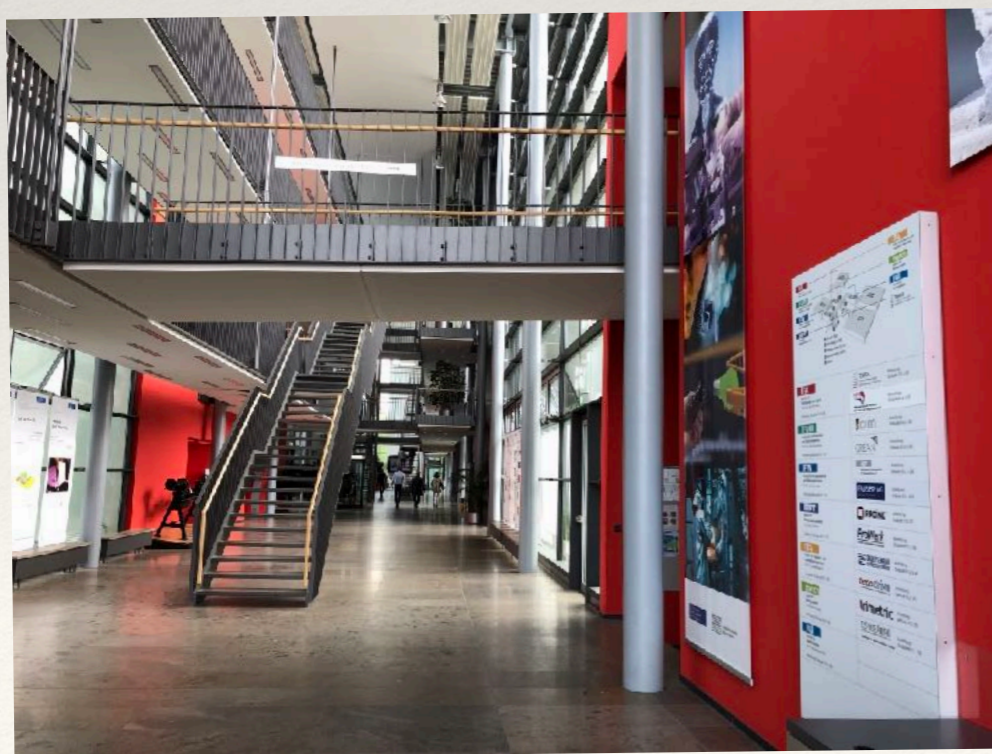


Europe map

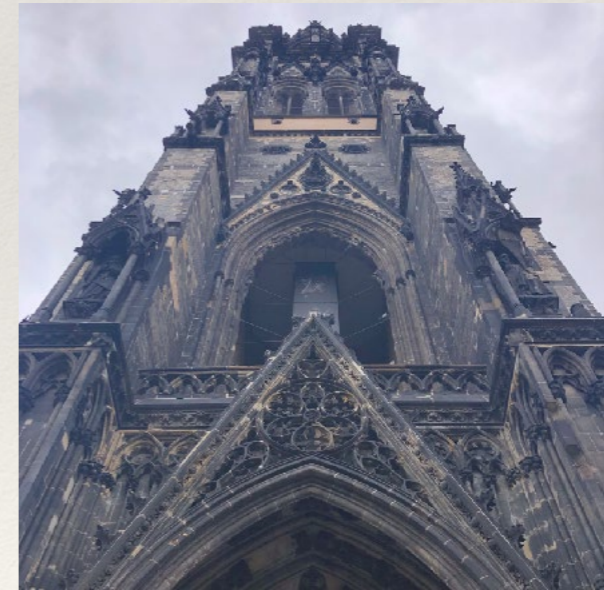
Hannover



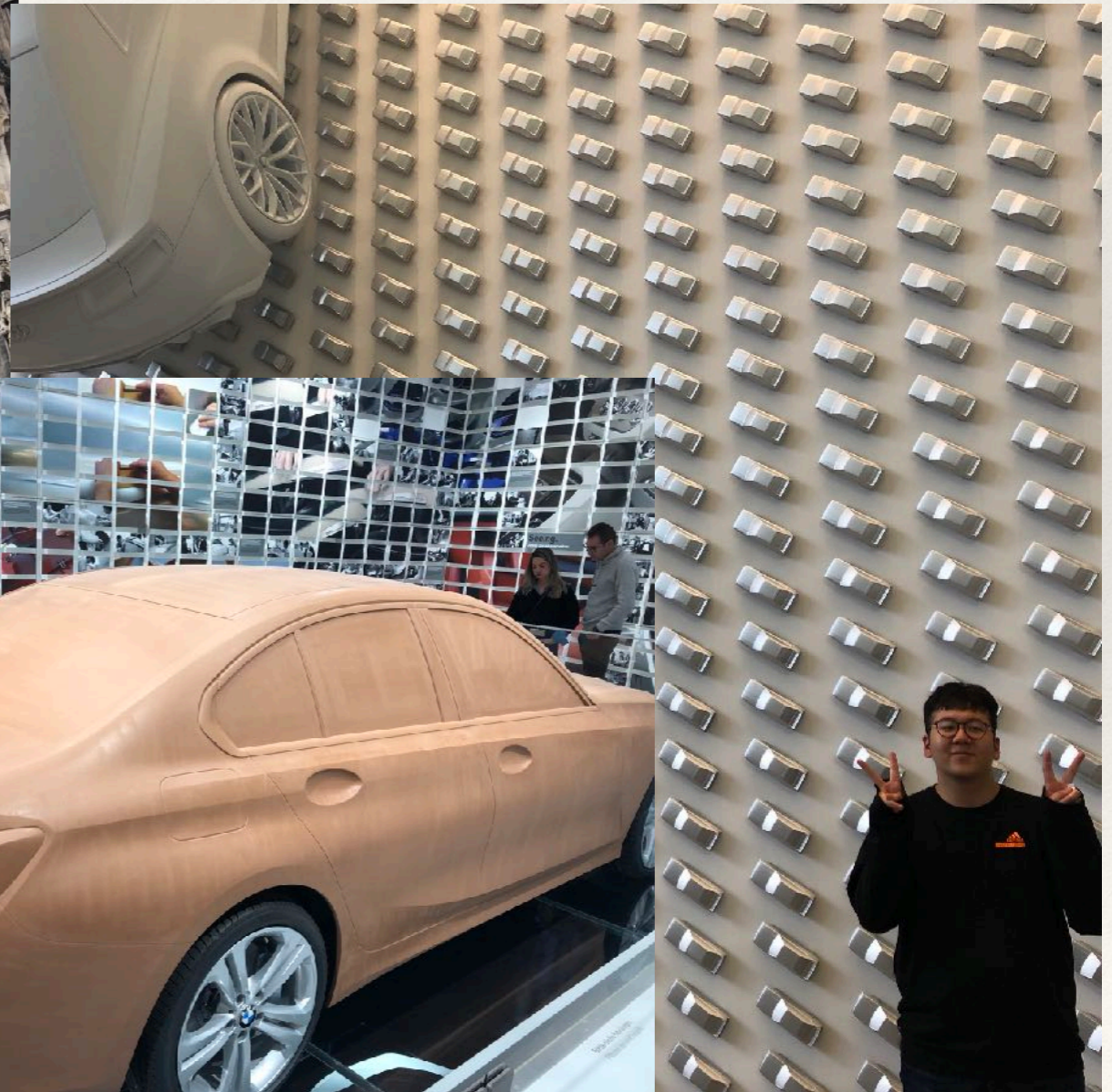
IFW



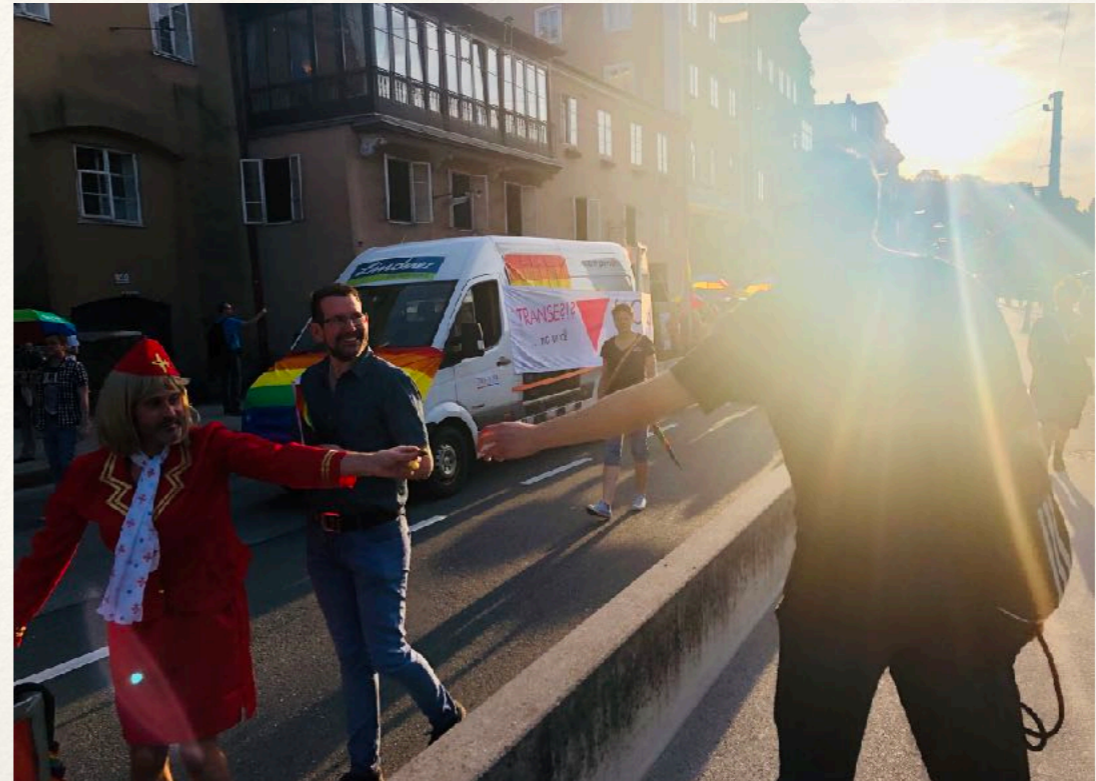
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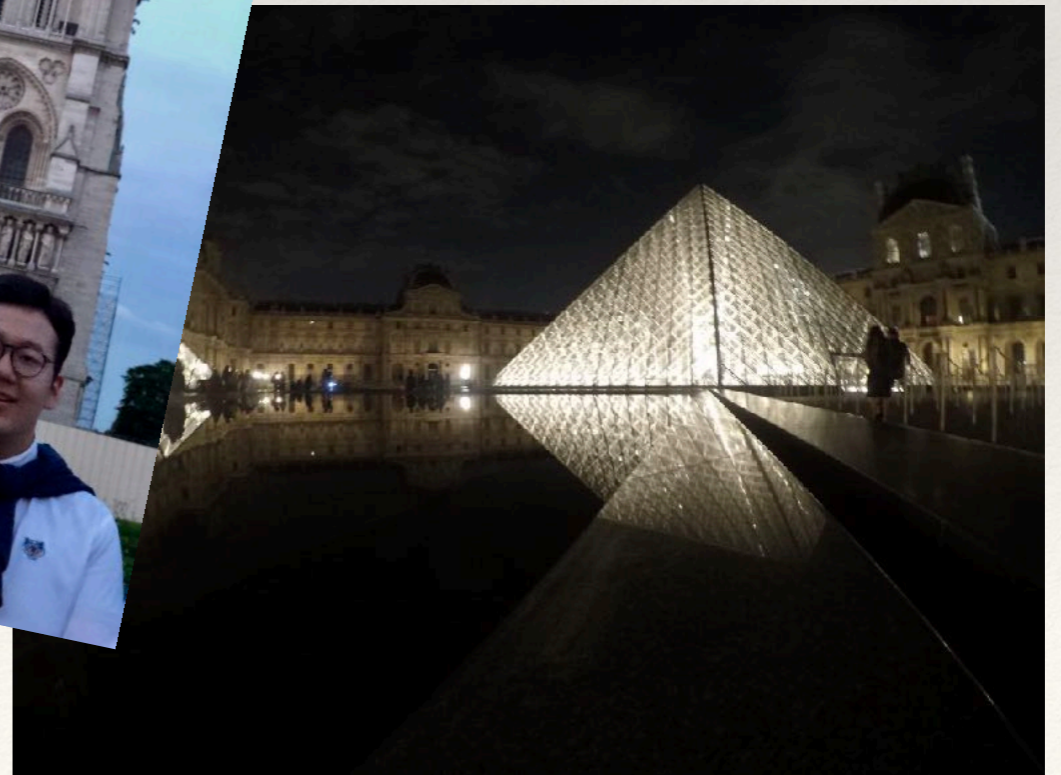
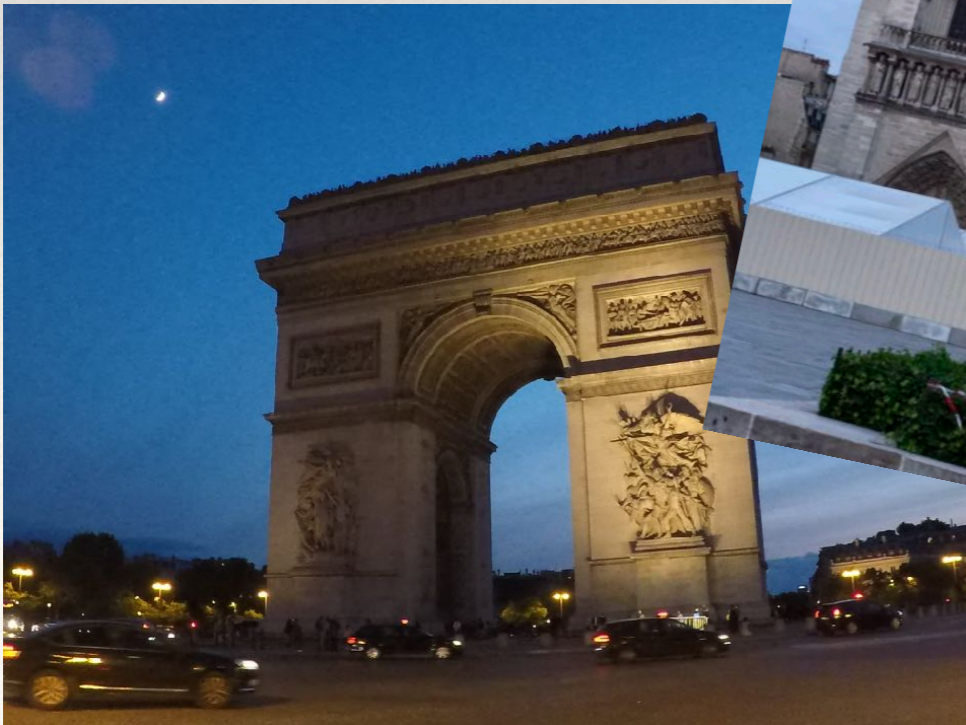
Munich



Salzburg



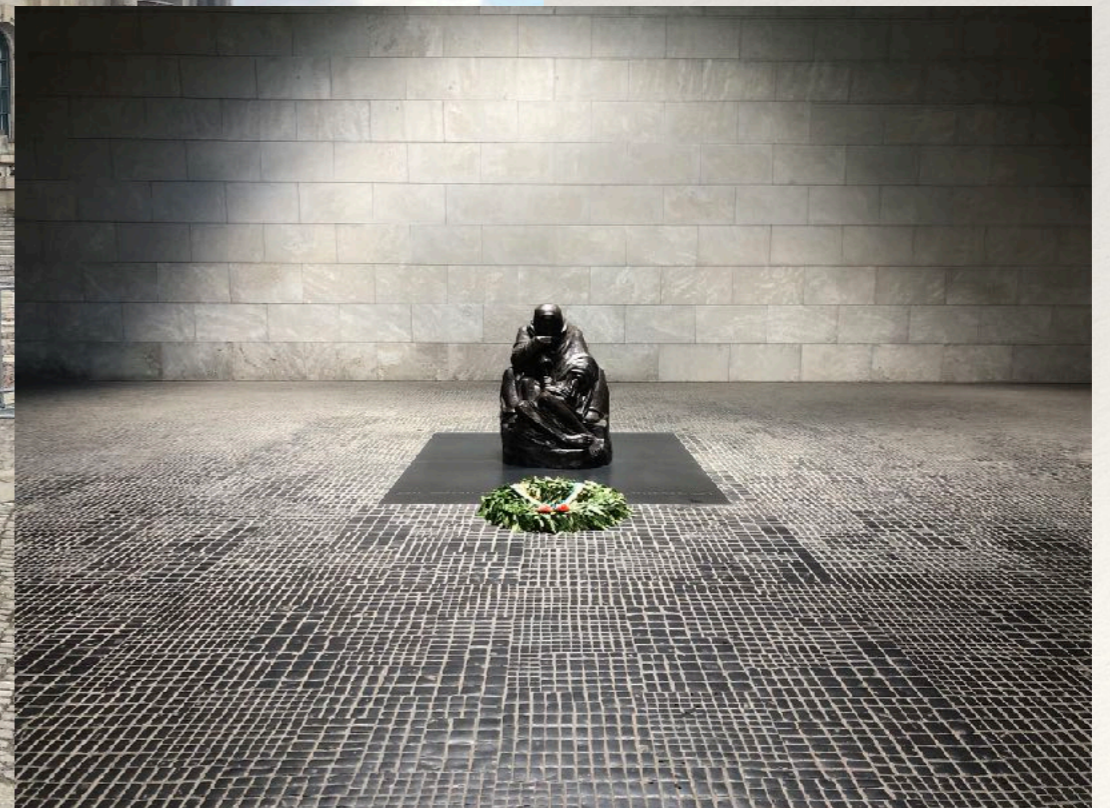
Paris



Cologne, Frankfurt and Düsseldorf



Berlin



Amsterdam



“It is better to travel ten thousand miles than to read ten thousand books”

Reference

- ❖ Robert Kim, May 12th, 2019, "What is a Low Pass Filter? A tutorial on the Basics of Passive RC filters", <https://www.allaboutcircuits.com/technical-articles/low-pass-filter-tutorial-basics-passive-RC-filter/>
- ❖ Lee Scott, June 29th, 2017, https://blogs.msdn.microsoft.com/uk_faculty_connection/2017/06/29/running-matlab-on-azure-provision-a-matlab-distributed-computing-server-using-azure-vms/
- ❖ <https://www.google.com/maps>

Dank!