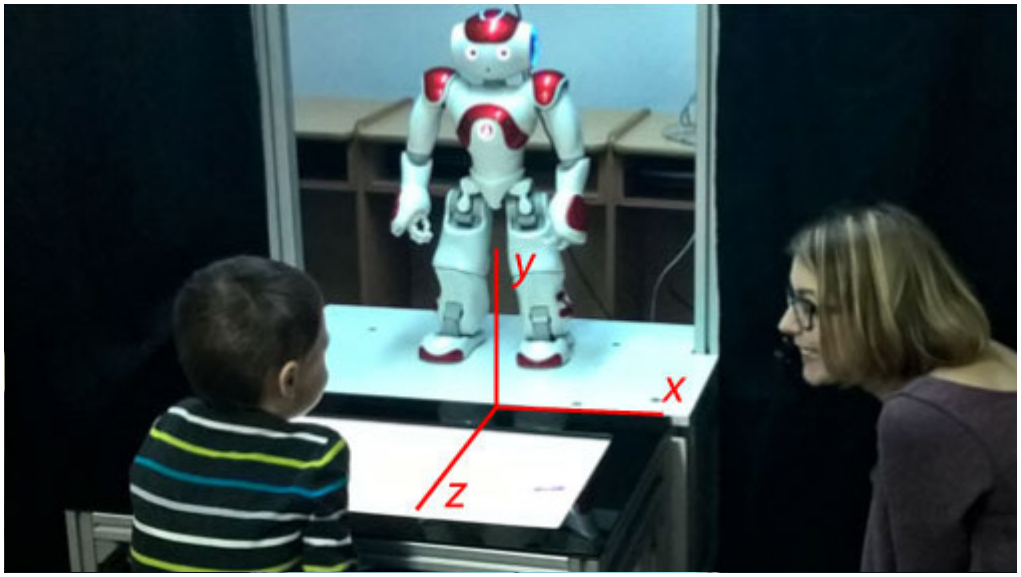
DREAM Dataset

Within the European research project DREAM: Development of Robot-Enhanced therapy for children with AutisM spectrum disorders, a large evaluation of *Robot Assisted Therapy (RAT)* has been conducted, compared to *Standard Human Treatment (SHT)*. Both conditions follows a *Applied Behavior Analysis (ABA)* protocol. 76 children diagnosed with *Autism Spectrum Disorders (ASD)* participated, going through a total of 3500 therapy sessions and more than 300 hours of therapy. Each session was recorded with three RGB cameras and two RGBD (Kinect) cameras, providing detailed information of children's behavior during therapy.

The DREAM Dataset is available at github.com/dream2020/data and comprise eye-gaze and 3D skeleton data for upper body of the participating children, all recorded in a joint frame of reference. This notebook demonstrates how to read and visualize the DREAM dataset using Python 3.

The experimental setup used for all recordings in this dataset is displayed below. The red axes labeled x,y,z visualizes the coordinate system in relation to the physical environment.



Usage

This notebook can be read as a standard document and will provide a brief overview of how

to understand the data without the need to execute any code on your own machine. However, you may also download and execute this notebook locally using Jupyter. Jupyter is part of Anaconda and we recomment that you run this notebook through the complete Anaconda distribution.

One you have Anaconda installed, you may clone the DREAM dataset repository from github.com/dream2020/data. This notebook comes with the dataset and is opened using the Jupyter explorer.

First, let's import the dataset tools provided with DREAM dataset...

In [5]:
```
%load_ext autoreload
%autoreload 2
import dataset_tools as dataset
```

Next, we import a couple of generic libraries for plotting and data handling...

In [6]:
```
%matplotlib inline
import os
from matplotlib import pyplot as plt
import matplotlib
import numpy as np
import pandas as pd
```

Now, we are ready to load the dataset and plot it's basic JSON structure.

In [7]:
```
data = dataset.open('../dataset/data_example.json')
print(data.structure())
```


```
{
    "$id": "User 37_18_Intervention 2_20171102_123242.369000.json",
    "$schema": "https://raw.githubusercontent.com/dream2020/data/master/speci
fication/dream.1.2.json",
    "ados": {
        "preTest": {
            "communication": 2,
            "interaction": 5,
            "module": 1.0,
            "play": 1,
            "protocol": "ADOS-G",
            "socialCommunicationQuestionnaire": 23,
            "stereotype": 0,
            "total": 7
        }
    },
    "condition": "RET",
    "eye_gaze": {"rx": [],"ry": [],"rz": []},
    "frame_rate": 25.1,
    "head_gaze": {"rx": [],"ry": [],"rz": []},
    "participant": {"ageInMonths": 47,"gender": "male","id": 37},
    "skeleton": {
        "elbow_left": {"confidence": [],"x": [],"y": [],"z": []},
        "elbow_right": {"confidence": [],"x": [],"y": [],"z": []},
        "hand_left": {"confidence": [],"x": [],"y": [],"z": []},
```

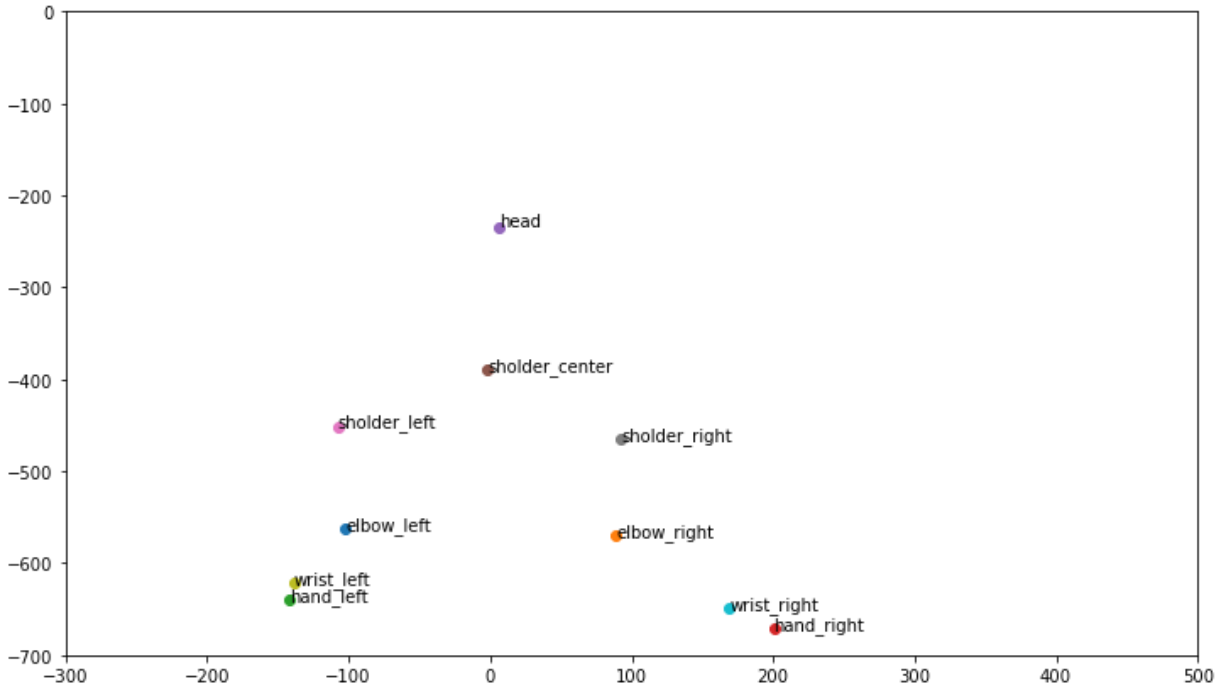
```
        "hand_right": {"confidence": [],"x": [],"y": [],"z": []},
        "head": {"confidence": [],"x": [],"y": [],"z": []},
        "sholder_center": {"confidence": [],"x": [],"y": [],"z": []},
        "sholder_left": {"confidence": [],"x": [],"y": [],"z": []},
        "sholder_right": {"confidence": [],"x": [],"y": [],"z": []},
        "wrist_left": {"confidence": [],"x": [],"y": [],"z": []},
        "wrist_right": {"confidence": [],"x": [],"y": [],"z": []}
    },
    "task": {
        "ability": "TT",
        "difficultyLevel": 1,
        "end": 10279,
        "index": 18,
        "start": 0
    },
    "time": "2017-11-02T12:32:42.369000"
}
```


Frontal view

In [8]:

```
fig, ax = plt.subplots(1,1,figsize=(12, 7))
skeleton = data['skeleton']
frame = 25*16
for key in skeleton:
    x,y = skeleton[key]['x'][frame],skeleton[key]['y'][frame]
    ax.plot(x,y,'o')
    ax.text(x,y,key)
ax.axis([-300,500,-700,0])
```

Out[8]: (-300.0, 500.0, -700.0, 0.0)

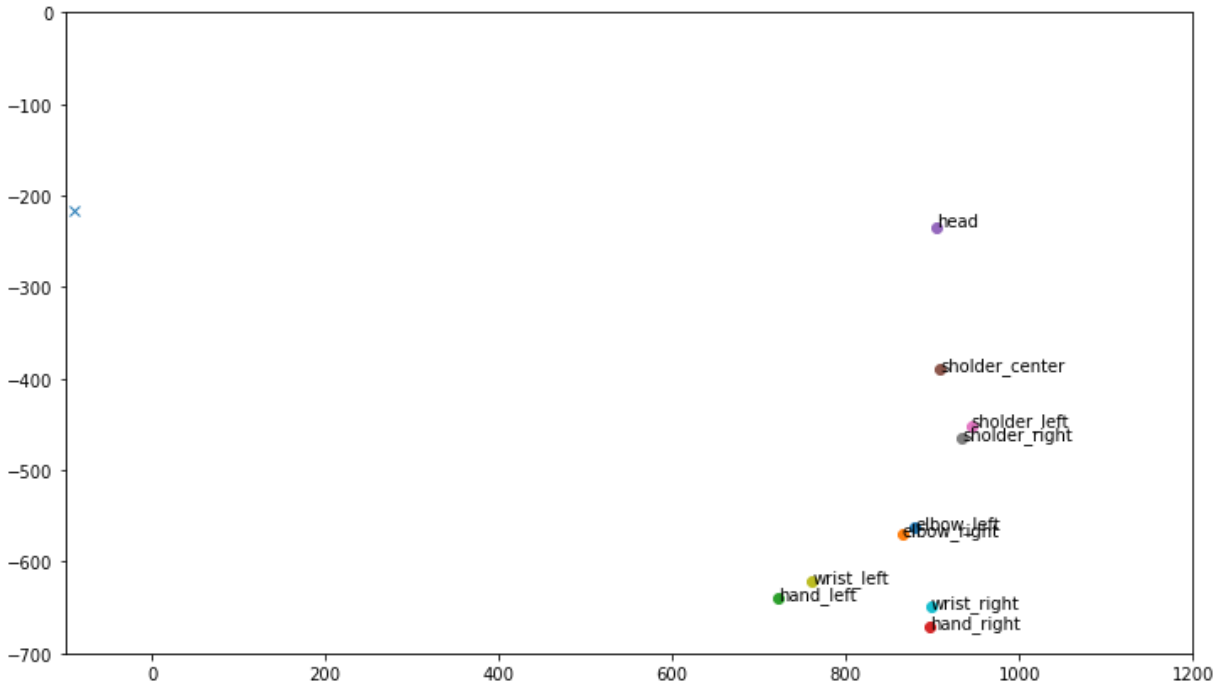


Side view

In [9]:
```
fig, ax = plt.subplots(1,1,figsize=(12, 7))
for key in skeleton:
    x,y = skeleton[key]['z'][frame],skeleton[key]['y'][frame]
    ax.plot(x,y,'o')
    ax.text(x,y,key)

gaze = data.gaze()[frame]
ax.plot(gaze[2],gaze[1],'x')
ax.axis([-100,1200,-700,0])
```

Out[9]: (-100.0, 1200.0, -700.0, 0.0)



Exporting data to other formats

The dataset tools library adds convenience methods for representing the DREAM intervention json-files as DataFrames, from which you can export the data to a variety of different formats.

In [10]:
```
myDataFrame = data.to_dataFrame()
```

In [11]:
```
data.to_csv('data.csv')
```

Working with multiple session files

The intervention protocol used for the clinical study where the DREAM dataset was collected comprise an initial diagnosis, up to 8 interventions, and a final diagnosis. In practice, an intervention is deliverted as a number of *sessions*, where the child is visiting the clinic and

interacting with the robot. The DREAM dataset comprise one json-file for each recorded session. The precise number of sessions can vary as a result of practical time constraints, the childs needs for breaks, etc, which also means that the dataset comprise a different number of session files (json-files) for each child.

Each session is associated with a task, specifying what the child is expected to do during that session. Many times it is useful to analyse data over multiple sessions to see trends or differances between conditions.

Below is a short code displaying all sessions for *User 13*. The code loads each file and tisplays some information about the task, targeting *turn taking (TT)*, *joint attention (JA)*, or *imitation (IM)*. The complete intervention protocol is described in *DREAM Deliverable 1.1*, https://github.com/dream2020/DREAM/blob/master/docs/deliverables/DREAM_Deliverable_D1.1.pdf.

In [20]:
```
tasks = []
for root, dirs, files in os.walk('../../DREAMdataset/User 13'):
    for f in files:
        if not f.endswith('.json'): continue
        data = dataset.open(os.path.join(root,f))
        t = data["task"]
        t['intervention'] = f.split('_')[2]
        t['sourceFile'] = f
        tasks.append(t)
sessions = pd.DataFrame(tasks)
sessions.sort_values(by='index',inplace=True)
sessions.set_index('index')
```

Out[20]:

index	ability	difficultyLevel	end	start	intervention	sourceFile
0	TT	1	3829	0	diagnosis abilities	User 13_0_diagnosis abilities_20170324_110537....
1	TT	1	13170	41	diagnosis abilities	User 13_1_diagnosis abilities_20170324_110817....
2	JA	2	8481	86	diagnosis abilities	User 13_2_diagnosis abilities_20170324_112013....
3	TT	1	11280	0	diagnosis abilities	User 13_3_diagnosis abilities_20170324_112732....
4	IM	2	8191	0	diagnosis abilities	User 13_4_diagnosis abilities_20170324_113750....
5	TT	1	10928	55	intervention 1	User 13_5_intervention 1_20170327_105800.80900...
6	TT	1	4722	79	intervention 1	User 13_6_intervention 1_20170327_110738.84100...
7	TT	1	2918	0	intervention 1	User 13_7_intervention 1_20170327_111053.26700...
8	JA	2	2440	25	intervention 1	User 13_8_intervention 1_20170327_111307.99800...

index	ability	difficultyLevel	end	start	intervention	sourceFile
9	TT	1	11282	104	intervention 1	User 13_9_intervention 1_20170327_111556.86800...
10	IM	2	2822	32	intervention 1	User 13_10_intervention 1_20170327_112727.7260...
11	IM	2	3615	0	intervention 1	User 13_11_intervention 1_20170327_113305.3910...
12	JA	2	1972	9	intervention 2	User 13_12_intervention 2_20170331_110342.6330...
13	TT	1	12086	28	intervention 2	User 13_13_intervention 2_20170331_110511.8520...
14	TT	1	3999	82	intervention 2	User 13_14_intervention 2_20170331_111426.7150...
15	TT	1	18591	36	intervention 2	User 13_15_intervention 2_20170331_112659.5520...
16	IM	2	2791	38	intervention 2	User 13_16_intervention 2_20170403_110214.4680...
17	TT	1	8255	103	intervention 3	User 13_17_intervention 3_20170403_110601.9020...
18	TT	1	3499	56	intervention 3	User 13_18_intervention 3_20170403_111241.7370...
19	JA	2	3852	0	intervention 3	User 13_19_intervention 3_20170403_111609.1170...
20	TT	1	8847	21	intervention 3	User 13_20_intervention 3_20170403_112134.8670...
21	IM	2	9065	28	intervention 3	User 13_21_intervention 3_20170403_113433.8730...
22	TT	1	8068	115	intervention 4	User 13_22_intervention 4_20170407_110811.4040...
23	JA	2	3941	28	intervention 4	User 13_23_intervention 4_20170407_111405.8850...
24	TT	1	2998	32	intervention 4	User 13_24_intervention 4_20170407_111707.7210...
26	IM	2	1883	51	intervention 4	User 13_26_intervention 4_20170407_113154.9410...
27	TT	1	9548	0	intervention 4	User 13_27_intervention 4_20170407_113626.8100...
28	IM	2	3413	30	intervention 5	User 13_28_intervention 5_20170424_104826.7790...
30	TT	2	27406	191	intervention 5	User 13_30_intervention 5_20170424_105241.4090...
33	TT	2	8372	0	intervention 5	User 13_33_intervention 5_20170424_111752.9100...

index	ability	difficultyLevel	end	start	intervention	sourceFile
34	TT	2	3863	0	intervention 5	User 13_34_intervention 5_20170424_112340.3720...
35	JA	3	8546	32	intervention 5	User 13_35_intervention 5_20170424_113156.7210...
43	JA	3	3670	133	intervention 6	User 13_43_intervention 6_20170508_130804.6120...
44	TT	2	3702	37	intervention 6	User 13_44_intervention 6_20170508_131043.5010...
45	TT	2	8318	0	intervention 7	User 13_45_intervention 7_20170508_131329.7860...
46	TT	2	5739	0	intervention 7	User 13_46_intervention 7_20170508_133223.4780...
46	TT	2	8175	0	intervention 7	User 13_46_intervention 7_20170508_132021.5400...
47	IM	2	2989	21	intervention 7	User 13_47_intervention 7_20170508_133730.1270...
49	TT	2	3645	202	intervention 7	User 13_49_intervention 7_20170512_131517.9380...
50	JA	3	2876	87	intervention 8	User 13_50_intervention 8_20170512_131809.5210...
51	TT	2	8647	46	intervention 8	User 13_51_intervention 8_20170512_132018.1640...
53	TT	2	8930	0	intervention 8	User 13_53_intervention 8_20170512_132828.5650...
54	IM	2	3221	714	intervention 8	User 13_54_intervention 8_20170512_133723.4690...
55	TT	2	2617	0	intervention 8	User 13_55_intervention 8_20170512_134759.2510...
56	IM	2	3075	334	final diagnosis	User 13_56_final diagnosis_20170515_131616.724...
57	TT	2	7925	0	final diagnosis	User 13_57_final diagnosis_20170515_132030.791...
58	TT	2	3749	18	final diagnosis	User 13_58_final diagnosis_20170515_132558.284...

Further reading

For a more comprehensive visualization of the DREAM Dataset, please refer to the projects github page: https://github.com/dream2020/data and the DREAM Data Visualizer.