BLG456E
Robotics
ROS TF Library

Lecture Contents:

- /tf topic
- tf library
- Visualising TF
- Debugging TF

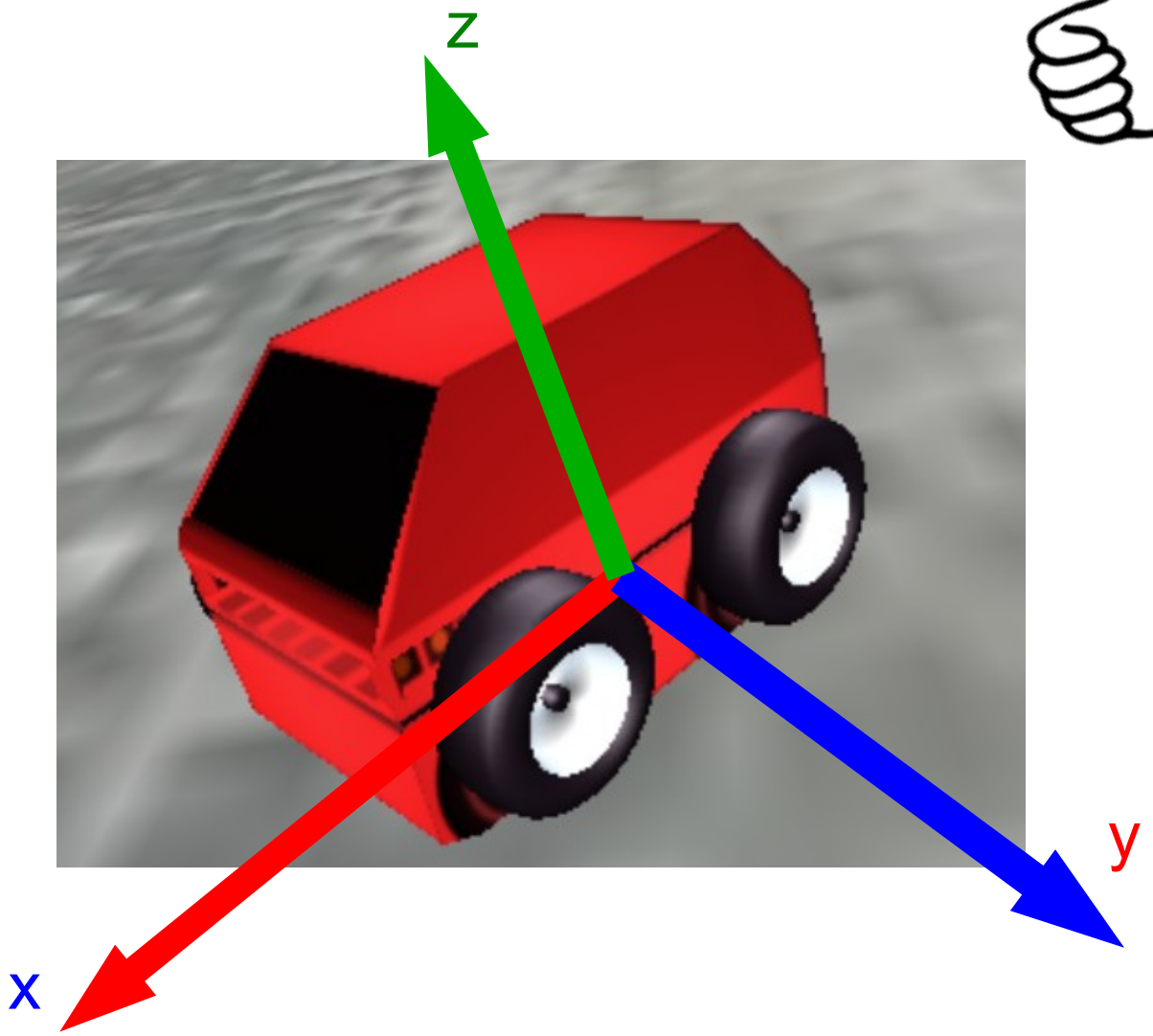
Lecturer:	Damien Jade Duff
Email:	djduff@itu.edu.tr
Office:	EEBF 2316
Schedule:	http://djduff.net/my-schedule
Course web:	Ninova
Slides:	Damien Duff

ROS robot coordinate frames convention

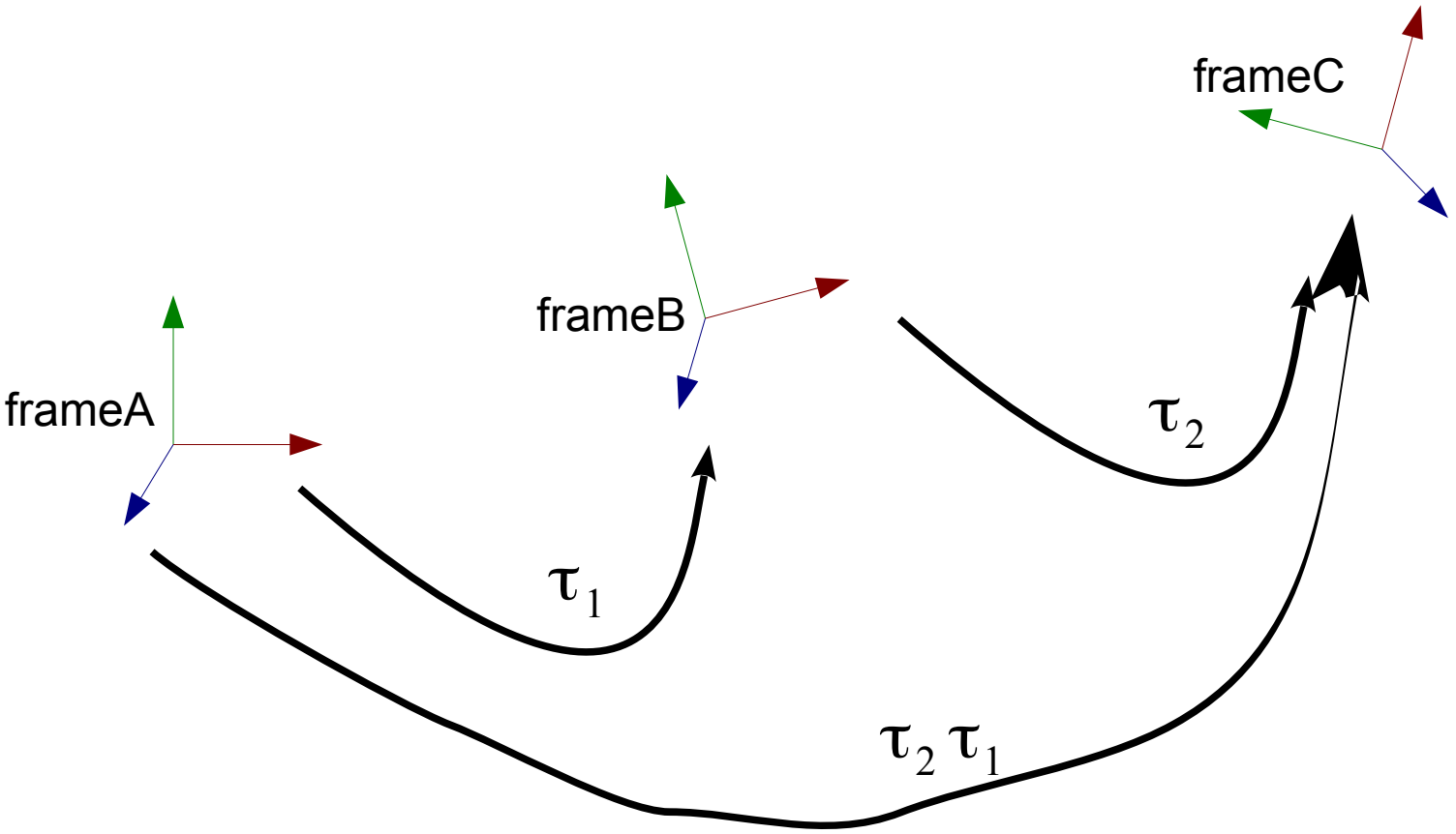
Mobile robots:

- **x** is forward.
- **y** is left.
- **z** is up.

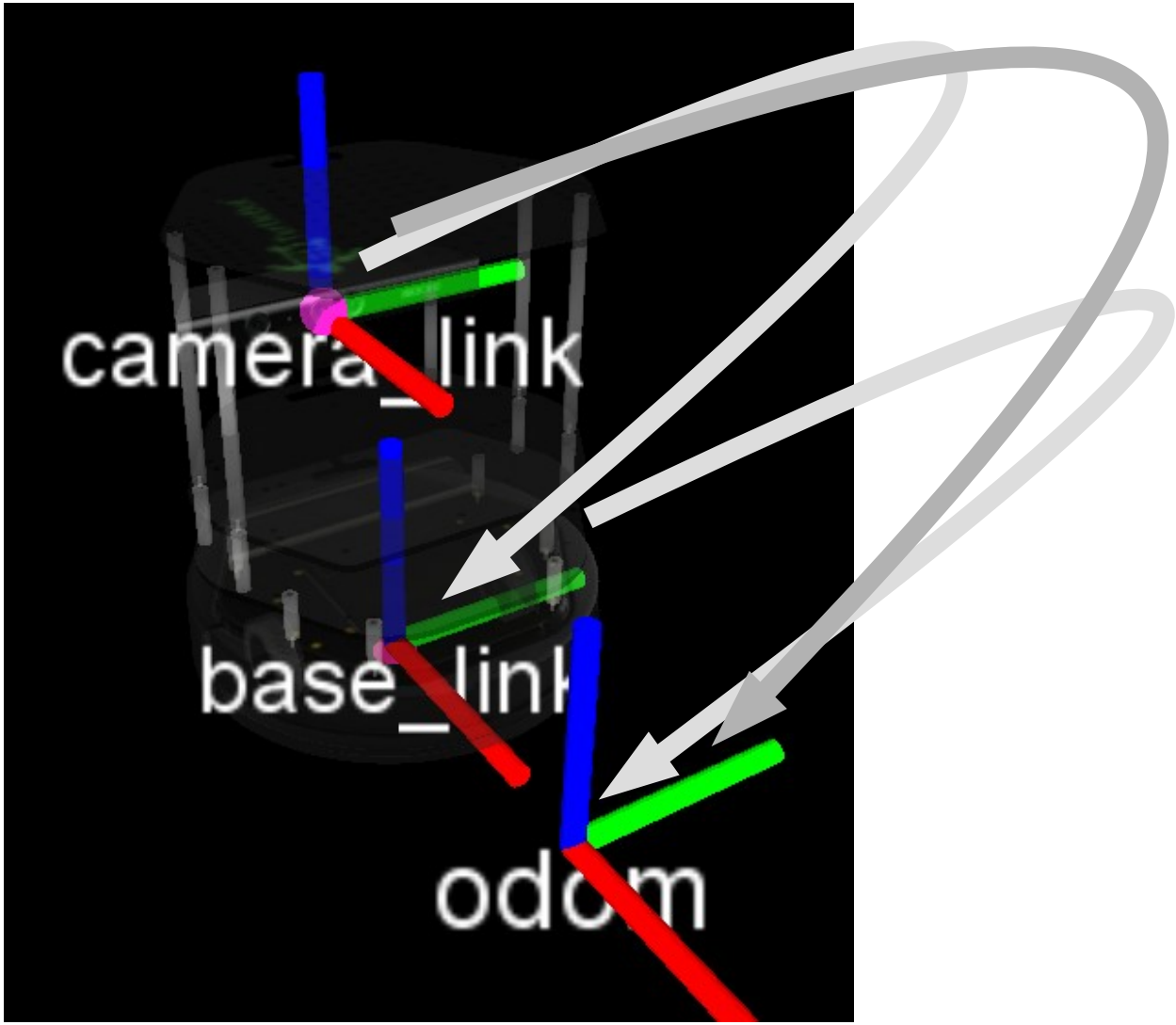
("right-handed coordinate system")



Recall: transformations between multiple frames



Reference frames / transforms in ROS (TF)



ROS tf & /tf

(note: transformation graph ≠ topic graph)

`/tf`

- A topic.
- Any node can publish transformations to it using the `tf` library.

See http://wiki.ros.org/tf/Tutorials

Example TF message

```
header:
        seq: 0
        stamp:
                secs: 11
                nsecs: 440000000
        frame_id: odom
child_frame_id: base_link
transform:
        translation:
                x: -0.135
                y: 0.0
                z: 0.009
        rotation:
                x: -0.707106781185
                y: 0.0
                z: 0.0
                w: 0.707106781188
```

ROS tf & /tf

(note: transformation graph ≠ topic graph)

`tf` is a library that

- Listens to the `/tf` topic for a node.
- Automatically composes transformations:

```
#include <tf/transform_listener.h>
…
ros::init(argc, argv, "transform_listening_node");
tf::TransformListener listener;
tf::StampedTransform transf;
...
listener.lookupTransform("base_link", "arm_link_3",
ros::Time(0), transf);
```

See http://wiki.ros.org/tf/Tutorials

Example: StampedTransform data structure

```
double robot_x = transf.getOrigin().x();

double robot_y = transf.getOrigin().y();

tf::Quaternion rotation = transf.getRotation();

tf::Vector3 axis = rotation.getAxis();

double angle = rotation.getAngle();

double robot_theta = angle*axis[2];
```

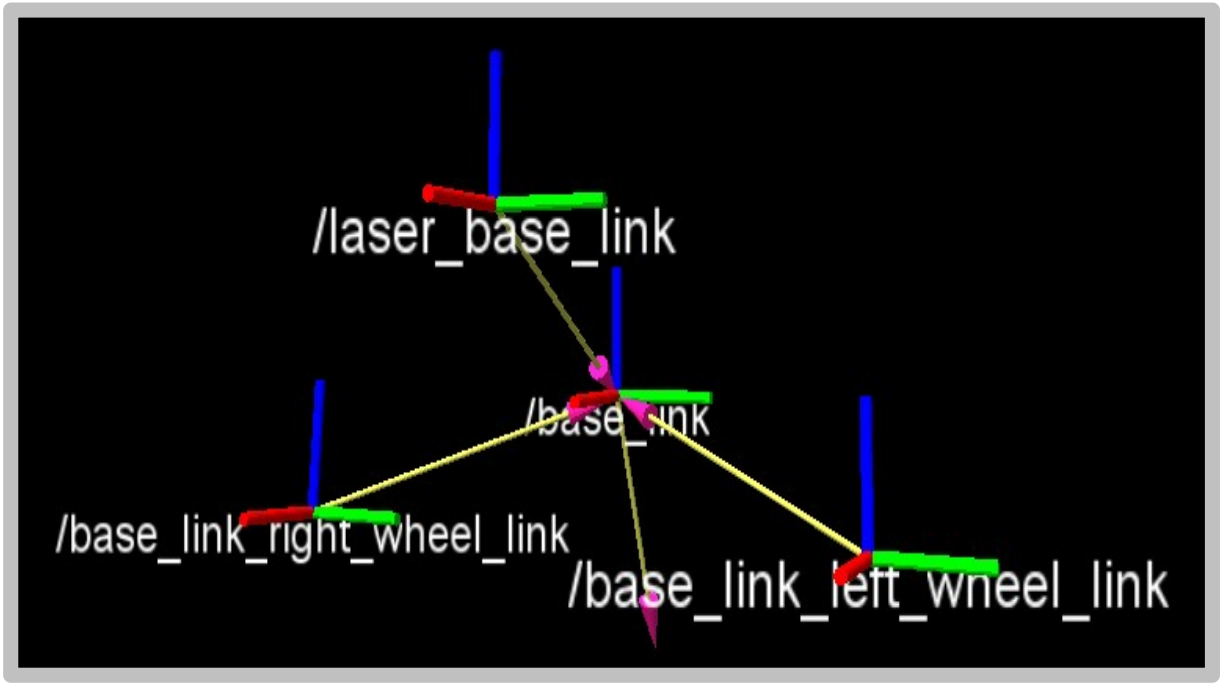
Tools for debugging tf

To visualise use:

```
rosrun tf view_frames
```

(produces frames.pdf)

Or add tf to rviz.



Tools for debugging tf

For fun, try:

```
rostopic echo /tf
```

To see transform between “odom” and “base_link” frames:

```
rosrun tf tf_echo /odom /base_link
```

Typical output:

```
At time 38.850
- Translation: [0.463, -0.002, 0.010]
- Rotation: in Quaternion [0.000, 0.000, 0.642, 0.766]
            in RPY [0.000, -0.000, 1.395]
```

Experiment with transforms

```
cd /opt/ros/indigo/lib/python2.7/dist-packages/tf/
ipython
import transformations
import math
help(transformations.rotation_matrix)
M=transformations.rotation_matrix(math.pi/2,(0,1,0))
Q=transformations.quaternion_from_matrix(M)
E=transformations.euler_from_matrix(M)
Q2=transformations.quaternion_from_euler(*E)
M2=transformations.quaternion_matrix(Q2)
R2=transformations.rotation_from_matrix(M2)
```