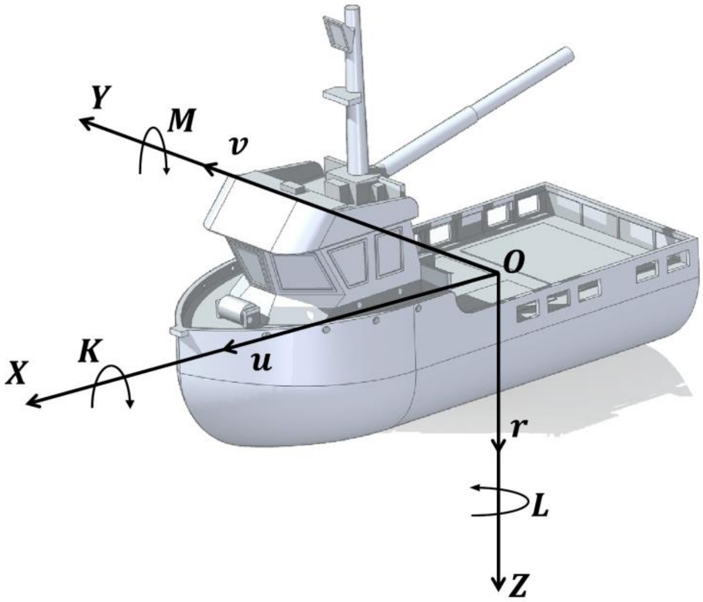
Consider mathematical description of a surface vessel dynamics:



$$m(\dot{v} + u_0 r + x_G \dot{r}) = Y_v v + Y_r r + Y_\delta \delta_R + Y_{\dot{v}} \dot{v} + Y_{\dot{r}} \dot{r}, \quad (1)$$
$$I_z \dot{r} + m x_G (\dot{v} + u_0 r) = N_v v + N_r r + N_\delta \delta_R + N_{\dot{v}} \dot{v} + N_{\dot{r}} \dot{r}, \quad (2)$$

where m is a mass; x_G is a center of mass coordinate; Y are transverse components of hydrodynamic forces; N are lateral components of hydrodynamic forces; I_z is a inertioa momentum; δ_R is a rudder angle.

Equations (1), (2) can be represented in a matrix form:

$$M_R \dot{x} + N_R(u_0) x = B_R \delta_R$$

where M_R is an inertia matrix; N_R is a matrix of Coriolis and centripheral forces; x is a velocity vector; B_R is an external momentum vector.

Matrices of the model (3) takes the form:

$$M_R = \begin{bmatrix} m - Y_{\dot{v}} & m - Y_{\dot{r}} \\ m x_G - N_{\dot{v}} & I_z - N_{\dot{r}} \end{bmatrix}, \quad (4)$$
$$N_r(u_0) = \begin{bmatrix} -Y_v & m u_0 - Y_r \\ -N_v & m x_G u_0 - N_{\dot{r}} \end{bmatrix}, \quad (5)$$
$$B_R = \begin{bmatrix} Y_\delta \\ N_\delta \end{bmatrix}, \quad (6)$$
$$x = \begin{bmatrix} v \\ r \end{bmatrix}, \quad (7)$$

Therefore, vessel dynamics model can be represented in state-space form:

$$\begin{cases} \dot{x} = Ax + B\delta_R, \\ y = Cx, \end{cases} \quad (8)$$

where $A = -M_R^{-1} N_R(u_0) = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$, $B = M_R^{-1} B_R$, $C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

Assume that an unmanned vessel is equipped with an INS, which includes a microelectromechanical gyroscope and an accelerometer. In this case, the gyroscope will provide the angular velocity measurement, and the linear velocity can be obtained by integrating the accelerometer readings.

It was generated 280 datasets with following parameters:

- Modeling time: 50 min
- Sampling time: 0.1 min
- Initial values of velocities: random from -1 to 1
- Noise of gyroscope: normal distribution with mean 0, variance 0.05
- Noise of accelerometers: normal distribution with mean 0, variance 0.1

- Input signal: random constant or harmonic signal with magnitude from -0.5 to 0.5
- Fault start: random value from 10 to 40 min
- Fault duration: random value from5 to 40
- Multiplicative fault value: random from 0.5 to 5
- Sticking of sensor data: random value from -10 to 10.

Dataset incudes following data for each moment of time:

- $u1$is a rudder angle
- $y1$ is a hyroscope value
- $y2$ is a accelerometer value
- $y1$ is a nominal gyroscope value based on the model
- $y2$ is a nominal accelerometer value based on the model
- $fault\_y1$ is a binary value, where 1 is a gyroscope fault
- $fault\_y1$ is a binary value, where 1 is a accelerometer fault