
**Ben Gurion University of the Negev**

**Faculty of Engineering Sciences**

**Department of Mechanical Engineering**


**Research project**

# Turbulent Flow course Project


Name: Benny Vradman


Date: 8.1.2025

# 1 Introduction

The project investigates turbulence in swirl flow. Swirl flow is charactarized by a helix flow swirl number

# 2 Governing equations

## 2.1 dimensional analysis

Swirl number:

$$S(x) = \frac{1}{R(x)} \frac{G_\theta(x)}{G_x(x)} \tag{1}$$

where $G_\theta$ is the time average of the axial component of angular momentum of the flow, $R$ is a characteristic radius of the swirling flow and $G_x$ is the time average of the flow rate of axial momentum [1]. The meaning of this swirl number is a ration between the angular momentum and the axial momentum of the flow, divided by the radius of the flow, at any position $x$ along the cross section of the flow.

connection the swirl number to Rossby number is:

$$Ro = \frac{U^*}{\Omega^* R}, \tag{2}$$

$$G_\theta = \pi \rho U^* \Omega R^4, \tag{3}$$

$$G_x = \pi \rho U^{*2} R^2 \tag{4}$$

# References

[1] Guillaume Vignat, Daniel Durox, and Sébastien Candel. The suitability of different swirl number definitions for describing swirl flows: Accurate, common and (over-) simplified formulations. *Progress in Energy and Combustion Science*, 89:100969, March 2022.