

Pre-Training Study Resources

Rockland training covers a range of topics (from o-ring theory to turbulence theory) to prepare you for operating Rockland equipment and processing microstructure data. There are no prerequisites to participate in Rockland training, however the resources included in this document will help prepare you to get the most out of the training. The resources are categorized by topic, your interest in a topic may shift if your role is primarily scientific or technical. If you do not feel comfortable with any of these topics ahead of the training, we strongly encourage you to brush up before the training. These youtube videos are an easy place to start, if you would like recommendations of relevant textbooks please contact our instructors. Other good resources to review ahead of training include instrument manuals, the Technical Notes available for download from the Rockland Website and the list of publications on our website.

Turbulence Theory

Highly Recommended

- **Classic Bob Steward Turbulence Theory Educational Film from 1968 (29-min video):**
<https://www.youtube.com/watch?v=AeBsiEYWZUY&t=48s>
A great, but old, video explaining the fundamental characteristics of turbulence. Recommended for any oceanographer, especially those new to turbulence. If the production quality drives you crazy, jump to the next recommended video.
- **Visualizing Turbulence (11-min video):**
<https://www.youtube.com/watch?v=UoTTq651dE>
A well-made video that explains the fundamental characteristics of turbulence. The introduction focuses on vortex rings and laser light sheets, but hang in there because the basics of turbulence are well explained starting at the 3-minute mark. The concepts are introduced for a gas (air), but they are directly transferable to liquids (just at different scales).
- **Turbulence in the Ocean (3-min video):**
<https://www.youtube.com/watch?v=dNKSrFE2Yv8>
A short video focusing on turbulence in the ocean and why it is important for global circulation. It focuses on a specific project "TRR 181: Energy transfers in Atmosphere and Ocean" funded by the German Research Foundation (DFG).

For more information and/or more detail

- **Turbulence Basics in a TED-X talk (12-min video):**
<https://www.youtube.com/watch?v=ePwVPmynMVO>
The basics of turbulence as explained by an aeronautical engineer. A useful video that introduces the difference between turbulent and laminar flows, and the Navier Stokes equations. He also talks about using supercomputers to study turbulent flows. Could be a useful video if you find yourself struggling to explain to family and friends exactly what turbulence is, and its prevalence in our world.

- **Turbulence energy cascade (3-min video):**
<https://www.youtube.com/watch?v=BWxsDVAgMH8>
A short video explaining the concept of the energy cascade and the velocity spectra. The production, inertial and dissipation subranges of the spectra are introduced.
- **Turbulence scaling and dimensional analysis (8-min video):**
<https://www.youtube.com/watch?v=dliZEgObjgs>
A follow-up to the previous video that introduces time and length scales, and the concept of dimensional analysis. A good video if dimensional analysis is new to you. Otherwise, it may be a little dry.
- **Description and Derivation of the Navier-Stokes Equations (11-min video):**
<https://www.youtube.com/watch?v=NjoMoH51UZc>
Step by step derivation of the basic Navier-Stokes equations from Newton's second law. Each of the terms is well explained and the simplification of the algebra is clearly outlined. A useful video if you want to better understand where these equations come from.
- **A Brief History of the Navier-Stokes Equations (6-min video):**
<https://www.youtube.com/watch?v=g-5bi7dxHP4>
A quick overview of how the Navier-Stokes equations came to be. The video is a little dry, but could be of interest if you like history and you want to see how many famous mathematicians had an influence on these equations.

Frequency Spectra and Time Series Analysis

Highly Recommended

- **Basic Concepts of Signal Processing with FFT (26-min video):**
<https://www.youtube.com/watch?v=AyUk-bZHJxl>
Good description of FFT processing parameters and considerations (particularly from 2:56 to 13:38). The effects of fft-length (referred to as block length in the video), windowing and leakage are explained. The rest of the video is focused on examples with an audio analyzer – it is still informative, but the application is specific to this instrument.
- **Frequency Spectra of a Seismogram (10-min video):**
<https://www.youtube.com/watch?v=SJ9LNNY7Rv4>
The first half of the video provides a good description of discrete sampling of a signal, the minimum sampling rate and the Nyquist frequency. A basic description of the Fourier Transform is also provided without too much detail. The second half of the video is not as relevant for turbulence data analysis but could be useful for interpreting spectrograms.

- **Frequency Content of Noise (8-min video):**
<https://www.youtube.com/watch?v=L7IHfwPlkuM>
Explanation of white noise, from a spectral perspective. Also explains the spectral shape expected for electrical interference.

For more information and/or more detail

- **Introduction to the Fourier Transform (13-min video):**
<https://www.youtube.com/watch?v=1JnayXHhjlg>
Good description of the basic mathematical concepts of Fourier Transforms for continuous signals.
- **Visualizing the Fourier Transform (20-min video):**
<https://www.youtube.com/watch?v=spUNpyF58BY>
Looking at the Fourier Transform in a different, but still very mathematical way. Might be useful if you prefer a graphical description
- **The Spectrum: The Mathematical Details (12-min video):**
<https://www.youtube.com/watch?v=xh5pLY3f6H8>
Detailed mathematical explanation of signal decomposition
- **What is a Fast Fourier Transform (FFT)? The Cooley-Tukey Algorithm (4-min Video):**
<https://www.youtube.com/watch?v=XtypWS8HZco>
Explains why the Fast Fourier Transform is faster than the discrete Fourier Transform.
- **What Makes a Fourier Transform Fast? (website):**
https://www.algorithm-archive.org/contents/cooley_tukey/cooley_tukey.html
Explains why the Fast Fourier Transform is faster than the discrete Fourier Transform.

Seamanship:

- **Line handling Safety (Video):**
<https://www.youtube.com/watch?v=3GsSMfLYIQg&list=PLZjHXxAYHAuv1mg9paokt1QKaUQKpY-WH> *Some basic line handling safety guidelines. Mostly applicable for big ships.*
- **How to tie a bowline (Video):** <https://www.youtube.com/watch?v=Q9NgGd7464U> *This is the recommended know for tying a rope tether to a VMP. Note that we also recommend securing the tail of the bowline with electrical tape and that is not shown in this video.*
- **Brummel lock-splice with one side fixed (Video):**
<https://www.youtube.com/watch?v=4WW7Qvg3VjI> *This is relevant for anyone performing Tow-
yo operations. Also see Technical Note-049.*

- **Winches and Cables Handbook (PDF):** <https://www.unols.org/sites/default/files/handbook.pdf>
*A huge amount of information and detail regarding winches and cables used in oceanography.
May be difficult to identify what is useful for a specific winch used with a Rockland VMP.*

Fun Turbulence Visualization

The Transition to Turbulence (Video): <https://www.youtube.com/watch?v=QzuzbwJWIYs> *a satisfying visualization of turbulence with pleasant music.*

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