# SPEARGUN DYNAMICS

## POSTGRADUATE THESIS OUTLINE

**Msc Gun Systems Design**

## ABSTRACT

There is little publicly available information regarding speargun dynamics [1]; the only academic output is An Analysis of Speargun Performance (Worthington, 2017) who also produced SpearTool.

This thesis proposes to build on the body of knowledge commenced by Worthington. Three power systems will be evaluated, recoil relationships will be quantified and projectile parameters varied whilst realizing viscous losses. This thesis will culminate in a model that can be used by the public to compare existing products and assist the prototyping of new designs.

## ANALYTICAL MODEL DEVELOPMENT

Develop an analytical model for conventional, roller and demultiplied spearguns

- Derive a latex rubber dataset (force vs % elongation graphing for a variety of brands and diameters)
- Quantify [speargun : shaft] weight ratio on mechanical efficiency.
- Quantify [recoil : energy] ratio of 14-20mm powerbands.
- Quantify recoil for each different powerband arrangement (conventional, roller and demultiplied) given same shaft velocity.
- Predict effective lengths of each speargun type for equivalent energy projection (incl mid-handle for each variant – 6 systems total)
- Predict speargun muzzle rise for a range of power options (whilst keeping shaft mass constant and allowing speed to vary) using kinematic analysis.

## EXPERIMENTAL REFINEMENT

- Quantify recoiling hydrodynamic drag effects (positive or negative) on mechanical efficiency.
- Quantify frictional differences between rail and enclosed tracks.
- Confirm viscous losses by measuring projectile and recoil velocity.
- Confirm a relationship between speargun energy, muzzle rise and shaft velocity; postulate on accuracy effects.

## RESOURCES REQUIRED

- Latex Rubber (various manufacturers: 14, 16, 18 & 20mm or imperial equivalent – approx. 3m of each)
- Speargun construction materials (x3)
- Force Meter (no less than 4,000 N)
- Evacuated pool
- High speed camera (min frame rate: 3,000 FPS) & pool periscope
- Underwater chronometer (up to 40 m/s, desirable not essential)

## OUTCOMES

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A mathematical model for design of spearguns (Ms Excel, potentially Wordpress) that factors recoil, mechanical efficiency and viscous losses.

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Shaft velocities given user input speargun configuration, dimensions and rubber parameters.

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Powerband diameters and lengths for a variety of speargun dimensions and projectile requirements.

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Submerged recoil and length efficiency comparison of conventional, roller and de-multiplied spearguns.

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Quantification of additional frictional losses (if any) from enclosed tracks compared to conventional rails.

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An energy storage comparison annex (force vs % elongation) of various brands and diameters of latex rubber.

[1] Manufacturers are likely hold corporate knowledge caches of varying quality that aren't publicly available