

# Measurements of the Level of Surgical Expertise Using Flight Path Analysis from *da Vinci* Robotic Surgical System

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**Purpose:** To create a method of objectively assessing surgical skill during minimally invasive surgery with *da Vinci* surgical system.

**Methods:** Real-time telemanipulator data, including elapsed time, position, orientation and grip (7 total degrees of freedom) and corresponding linear and angular velocities of the surgical tools in the *da Vinci*™ robotic surgical system, a telemanipulating computer assisted commercial FDA approved surgical device, were logged at 11 samples per second (for each signal) by an external computer. Two right-handed expert and four right-handed novice operator data logs were obtained when a bead was lifted, placed on a peg, and the surgical tool was returned to its origin using only one hand. The procedure was repeated five times per hand for each individual. The data was statistically analyzed with Student t-test and analysis of variance (ANOVA) tests. Significant differences in handedness of individual surgeons, and differences in the elapsed time it took to perform the task between experts and novices were determined.

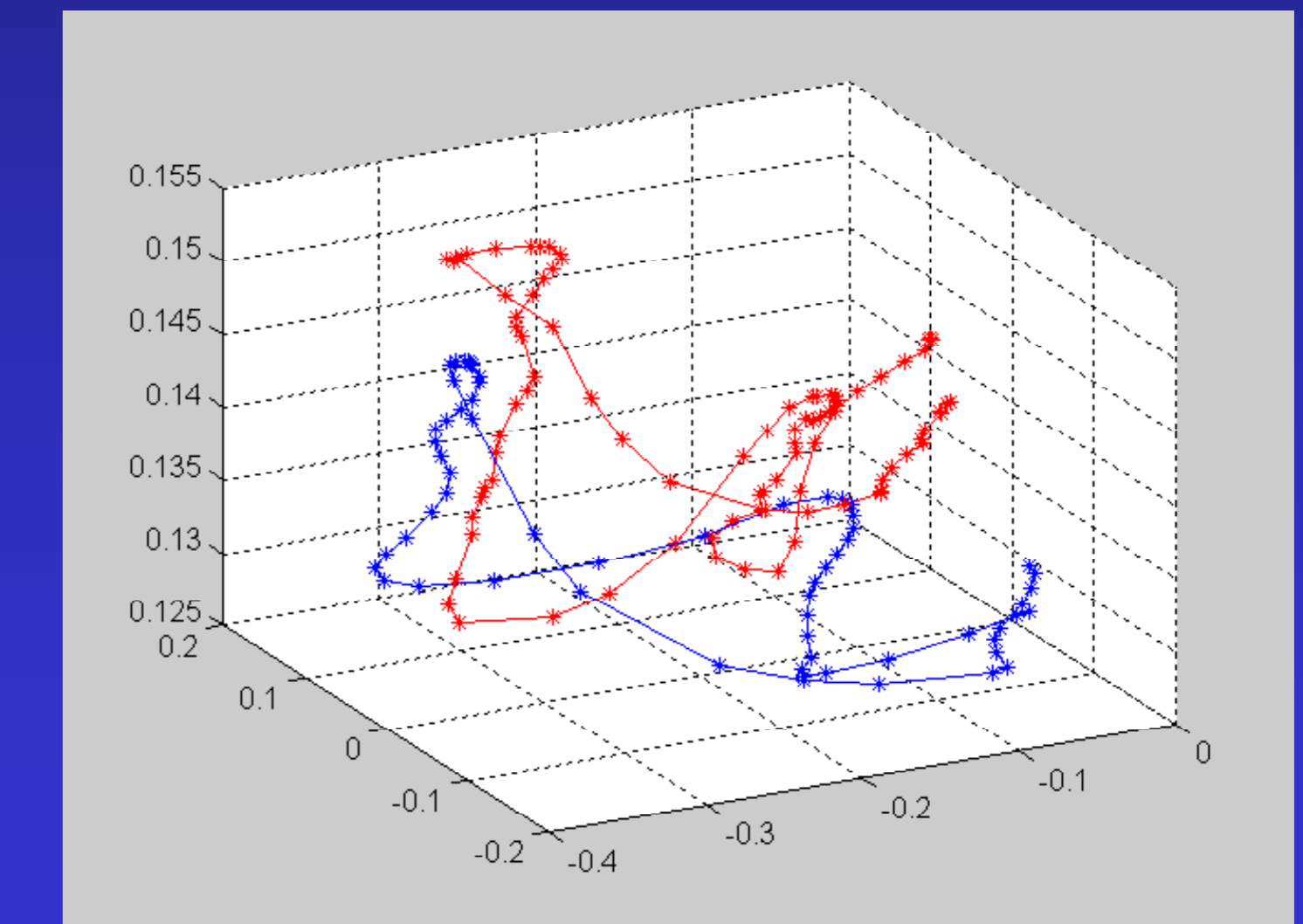
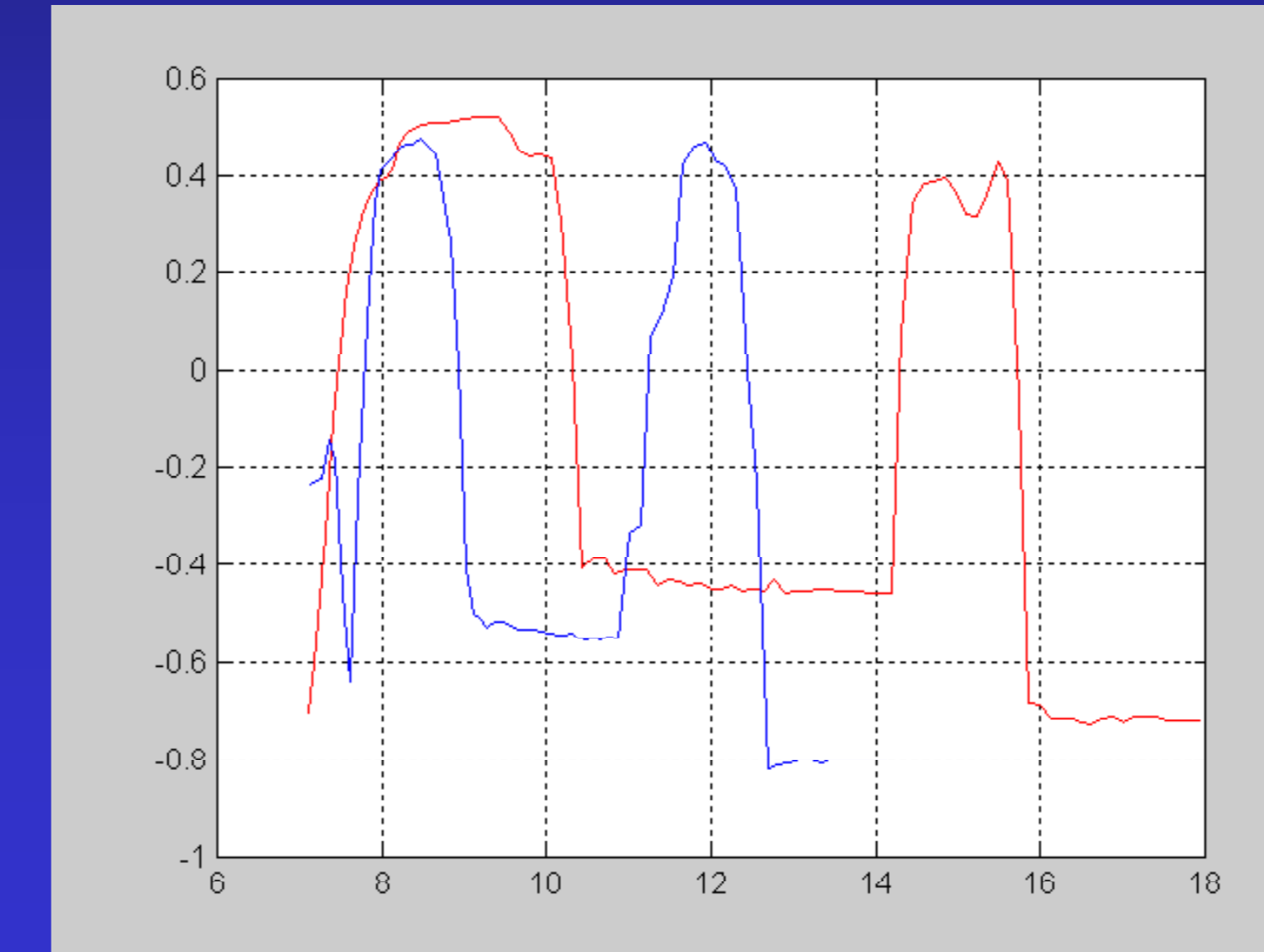
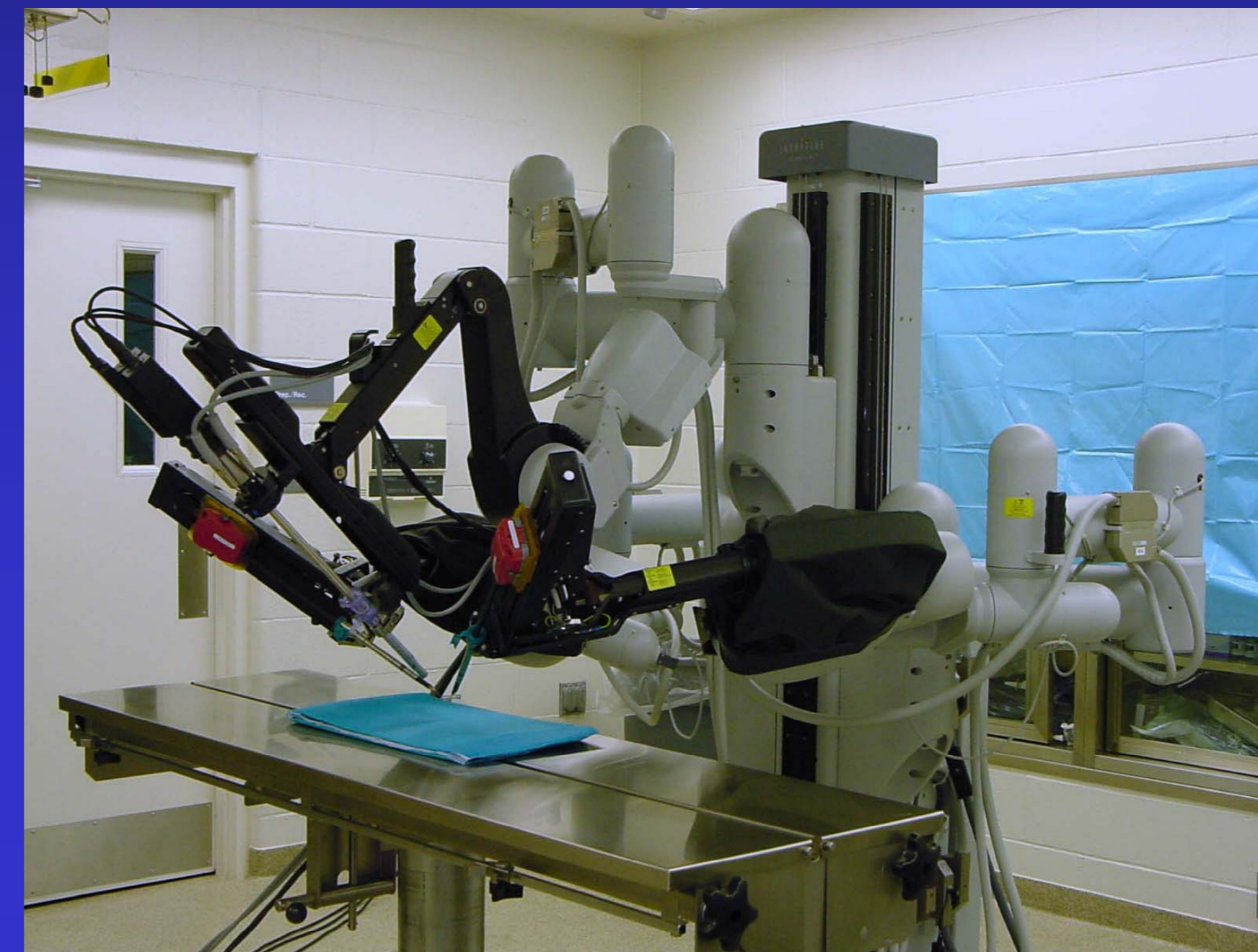
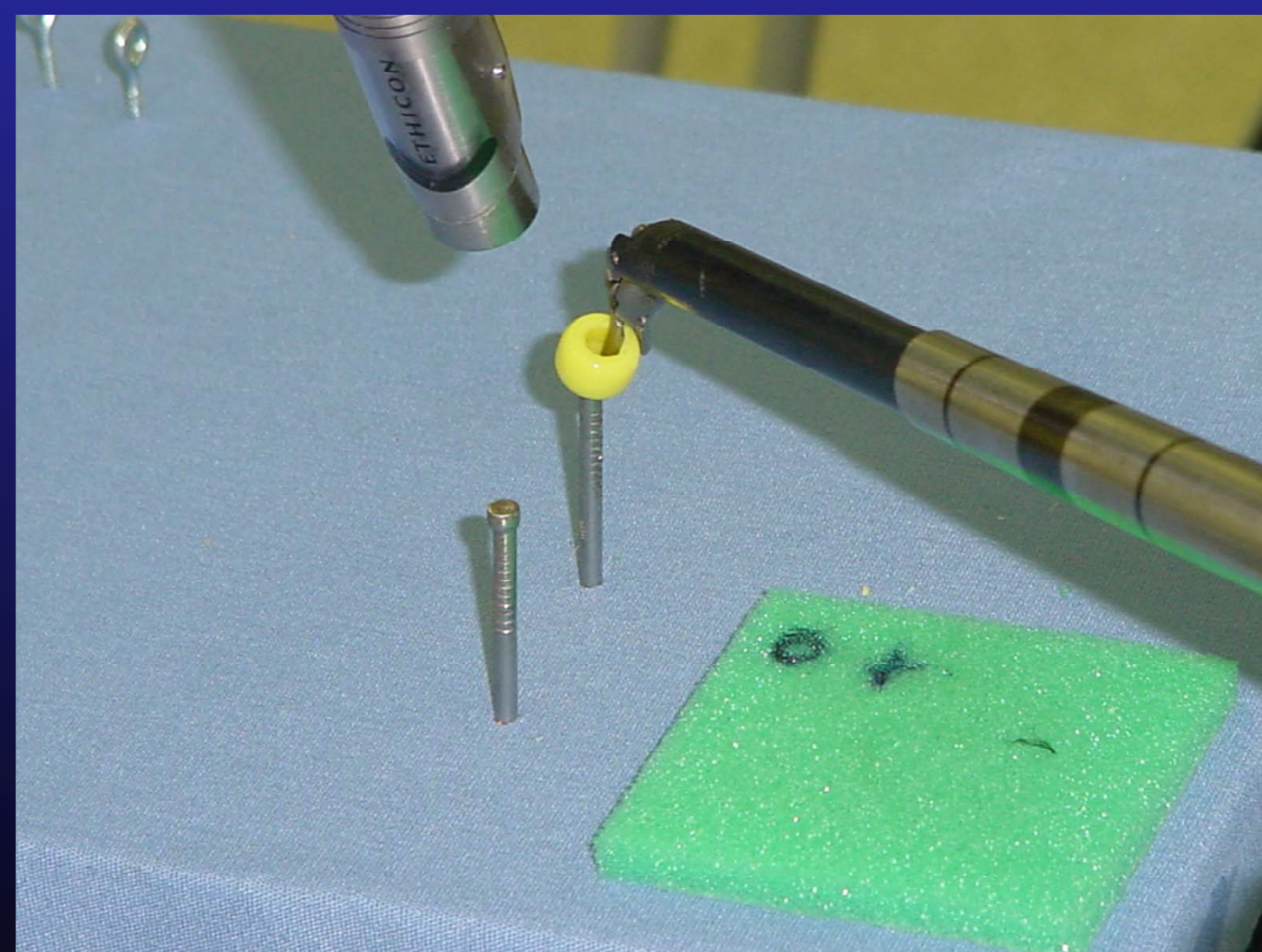


Table I. Flight path analysis of Novice and Expert operators performing task with *da Vinci* Surgical System.

Time:	Novice	Expert	P value
Average Time Left	13.536	8.649	0.044
Average Time Right	9.743	8.536	0.028
Inter-group P value	0.045	NS	
<b>Flight Path Mean Velocities:</b>			
X-axis (m/s)	0.100	0.121	0.000
Y-axis (m/s)	0.079	0.109	0.000
Z-axis (m/s)	0.008	0.008	NS
Rotational (rad/s)	0.256	0.288	0.026
Pivot (major) (rad/s)	0.205	0.231	0.036
Pivot (minor) (rad/s)	0.244	0.288	0.000
Jaw position (rad/s)	0.654	0.776	0.013



## Summary:

1. Comparison of the 3 dimensional trajectories demonstrates a visual disparity between expert and novice operators
2. Novices, but not experts, had a statistically significant difference in time between their right and left hands
3. Statistical analysis of variance in flight path data showed significant difference between novices and experts

**Conclusions:** Complex tasks in three-dimensional space could be analyzed with flight path calculations and level of expertise determined by objective measures. Mastery was demonstrated by shorter times to complete the task as well as in the pattern of positions and velocities of the operator. The effect of handedness diminished with the level of expertise.

## References:

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