



## ICE - Related Rates



Figure 1: Libyan President Colonel Muammar Abu Minyar al-QADHAFI, better known to the west as Gadaffi.

**In 1981 Colonel Gadaffi (the President of Libya - see Figure 1<sup>1</sup>) claimed the entire Gulf of Sidra as Libyan territorial waters (see Figure 2<sup>2</sup>).**

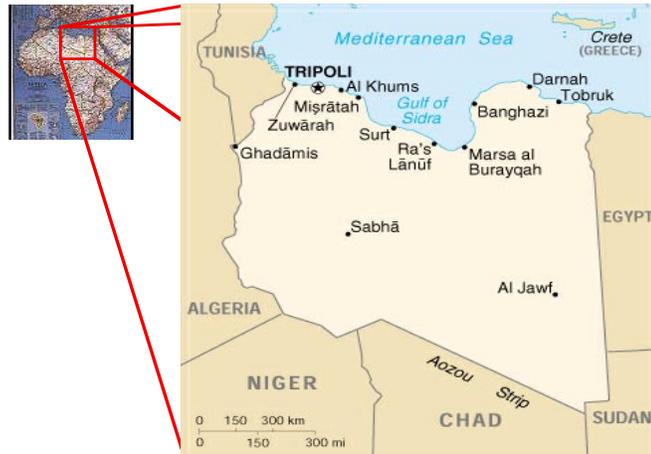


Figure 2: Location of the Northern African nation of Libya and the Gulf of Sidra.



Figure 3: Former US President Ronald Reagan.

**This action was not in accord with international conventions, and then President Ronald Reagan (see Figure 3<sup>3</sup>) challenged this position by conducting naval exercises in the Gulf<sup>4</sup>.**

**The admiral commanding these naval forces ordered F-14's (see Figure 4<sup>5</sup>) to patrol at a distance of ten miles from the Libyan coast. Any unidentified aircraft crossing the Libyan coast at a speed of greater than 500 miles per hour was to be treated as hostile.**

**Figure 5 shows one of the situations that developed during this crisis. An F-14 was**

<sup>1</sup> Image source: <http://www.goal.com/es/esp/>

<sup>2</sup> Image sources: CIA World Factbook, 2001. and <http://www.africaguide.com/>

<sup>3</sup> Image source: [http://reagan.webteamone.com/reagan\\_images.cfm](http://reagan.webteamone.com/reagan_images.cfm)

<sup>4</sup> Throughout these exercises, Libyan and US forces antagonized each other by approaching with every indication that they were preparing to attack. The most serious incident occurred on August 19, 1981, when a pair of Libyan Su-22 "Fitter" aircraft approached a pair of US Navy F-14's and fired an air-to-air missile. Both F-14's easily evaded the missile and returned fire destroying both Libyan aircraft.

<sup>5</sup> Image source: US Navy, <http://www.navy.mil/>



Figure 4: The F-14 Tomcat Fleet Defense Interceptor

*circling (essentially remaining near the same spot) at an altitude of approximately 5.7 miles. When the F-14 was 10 miles (diagonal distance) from the coast, its AWG-9 air search radar detected an object moving rapidly across the Libyan coastline. The AWG-9 measures the rate at which the distance between the F-14 and the target changes.*

*In this situation, the AWG-9 measured the rate of change of this distance to be 420 miles per hour.*

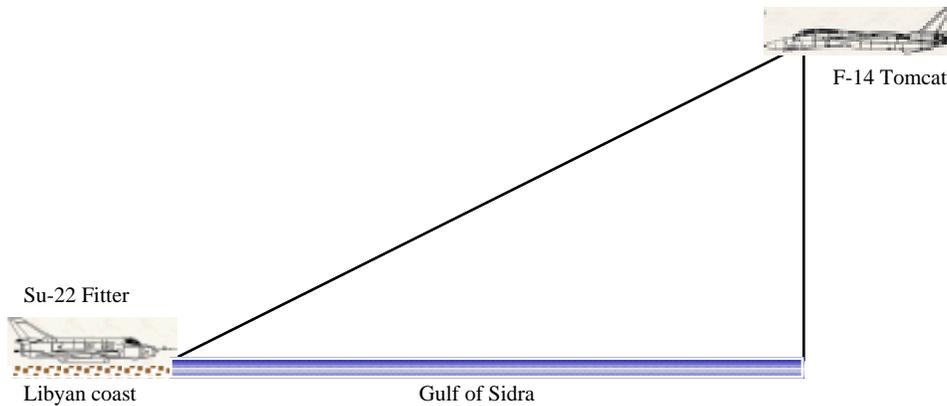


Figure 5: The situation at the start of the engagement.



Figure 6: A pair of Libyan Su-22 "Fitter" aircraft flying over a coastal region near the Gulf of Sidra.

*In 1981, the Libyan airforce included a number of high performance Soviet made aircraft such as the Su-22 "Fitter" (see Figure 6<sup>6</sup>). The top speed<sup>7</sup> of the Su-22 was approximately 1380 miles per hour.*

- *Should the F-14 crew regard this contact as hostile?*

<sup>6</sup> Image source: <http://www.tbe.aims.on.ca/keele/emir/su-22.htm>

<sup>7</sup> Source: <http://www.aerospaceweb.org/>