

# Parallel Plate Capacitor

Based on Hermes2D (<http://hpfem.org/hermes>)

## 1 Module Description

The parallel plate capacitor model calculates the distribution of the electric potential  $\varphi$  induced by stationary electric charges on the two plates of the capacitor. User-defined parameters include the material (specifying the permittivity  $\epsilon_r$ ), dimensions of the capacitor (the radius of the plates  $r$ , or the area of the plates  $S$ , and the distance between the plates  $d$ ), the two voltages, and accuracy of the FEM model.

The image below shows a historical model of a parallel plate capacitor with white-colored dielectric between the plates.



Figure 1: Parallel plate capacitor.

## 2 Underlying Equations

The equation for the electric potential  $\varphi$  is

$$-\operatorname{div}(\epsilon \nabla \varphi) = \varrho$$

where  $\varrho$  is electric charge density. Once the electric potential  $\varphi$  is calculated, the electric field vector  $E$  can be obtained as its negative gradient,

$$E = -\nabla \varphi.$$