BONAPARTE DVI

Bonaparte Disaster Victim Identification System

Bonaparte DVI is a next generation software system designed to facilitate quick victim identification in case of mass fatalities such as terrorist attacks, airline crashes and natural disasters.

www.bonaparte-dvi.com

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Disaster Victim Identification

Society is increasingly aware of the possibility of a disastrous event with a large number of fatalities. Recent examples are the WTC attacks, the tsunami, and airplane crashes and mass graves. In such an event, the recovery and identification of the remains of the victims is of great importance. Disaster victim identification (DVI) is greatly facilitated by the advent of modern DNA technology.

The identification task is the match of the unidentified victim with a reported missing person. When there is no reliable reference material of the missing person, DNA profiles of the relatives have to be used to identify the victims.

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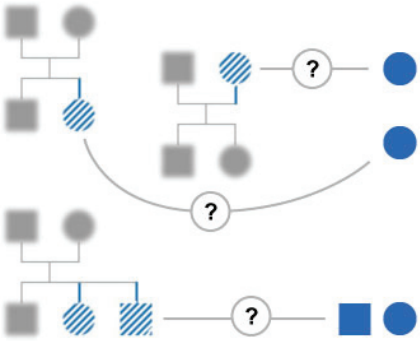
In cases of only a few victims, identification is a reasonably straightforward task for forensic researchers. The puzzle to match the victims and the missing persons is often still doable by hand (using a spreadsheet and/or software tools available on the internet).
However, large scale DVI is infeasible this way and an automated routine is indispensible for forensic institutes that need to be prepared for DVI.

Bonaparte is designed to deal with mass fatality incidents in a transparent, consistent,efficient and user friendly way.



Transparent

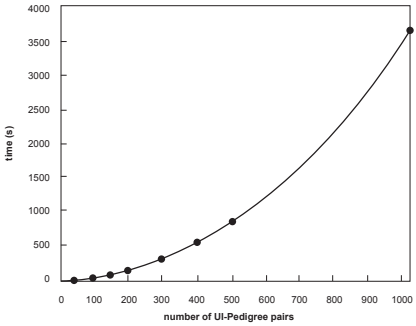
Family relations are defined as pedigrees. Bonaparte transforms the pedigrees into so-called Bayesian networks. These are the statistical models that are used for the likelihood computation. The models implemented in Bonaparte are well documented and available to end users.

Consistent

Bonaparte is an automated system that performs each calculation in exactly the same way and eliminates the human-error factor.

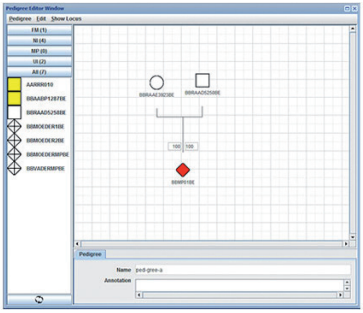
Efficient

Efficiency is important since the number of possible match combinations with the number of victims. Consider a case with 10 victims with their 10 putative pedigrees. This results in just 100 combinations, but 100 victims with their 100 pedigrees yields 10,000 combinations. For the latter case Bonaparte's computation time is in the order of minutes.



User friendly

Bonaparte has an intuitive graphical user interface. Data are organized in folders with projects. Projects contain all the information of individuals and pedigrees of a specific case. Pedigrees can be created by using the drag-and-drop pedigree editor. Web interfaces allow users to access the system using a webbrowser, without the need of installing software.



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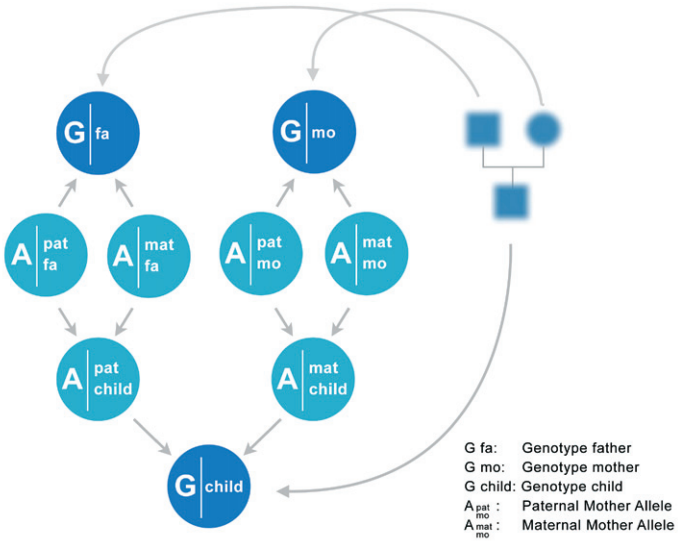
Bayesian Networks

Bayesian networks are a class of statistical models, which are very well suited to model the statistical relations of genetic material of relatives in a pedigree. Bayesian networks provide a modular approach of statistical modeling. Any pedigree of any size and topology, including inbreeding, is straightforwardly modeled as a Bayesian network. The general purpose Bayesian network algorithm is immediately ready for the required likelihood computations.

An additional advantage of the modular Bayesian network approach is their modeling flexibility. Other factors that play a role in the statistical analysis, such as mutation models, silent alleles, missing data, uncertainty in family relations etc. are easily and transparently incorporated in the same modeling framework.

Bonaparte automatically generates these networks in its computational engine.



Technical features

Connectivity and data integrity

Bonaparte manages its own data on a SQL database. Data can be imported in two ways: manually import of Excel files, or automatically via the XML import. The latter option is used to connect the system to existing infrastructure.

The use of XML as import format ensures that data from any source can be imported, whether it is coming from CODIS, PostgreSQL, Excel files or even plain text files. All imported data is validated against rules in XML Schema (XSD) files to avoid data corruption. The XML format documentation is available upon request.

External applications can connect and/or control to Bonaparte via http protocol. An example of such an application is the graphical user interface (GUI).

External report modules can easily be connected to Bonaparte.

Rewind and history tracking

The rewind capability means that users are able to select a historic version of the database (a view of the database at time t that filters out data created after time t) and work with that database. The purpose of this is that it might be required to re-confirm old matches or investigate what data was exactly available at a certain time (audit for legal reasons). This versioning is accomplished by keeping a full edit history of all data, allowing administrators to inspect who modified what, when and how.

User concurrency and access rights

The use of private branches ensures that different users can work with the same data at the same time without interfering. A user can start editing an object and work with this new object, while the rest of the users still see the object as it was before that editing took place. Only when the user chooses to publish his modifications they become visible to the other users as well. Unix style access rights can be defined per user.

Crash recovery

Since Bonaparte is a client-server based system, it is sensitive to network service interruptions or browser crashes. In order to minimize the loss of work in such events, a crash recovery mechanism has been implemented. The system automatically saves users work data to a private branch. In case of a crash, all users have to do is restart their browser and they can resume editing where they left off.

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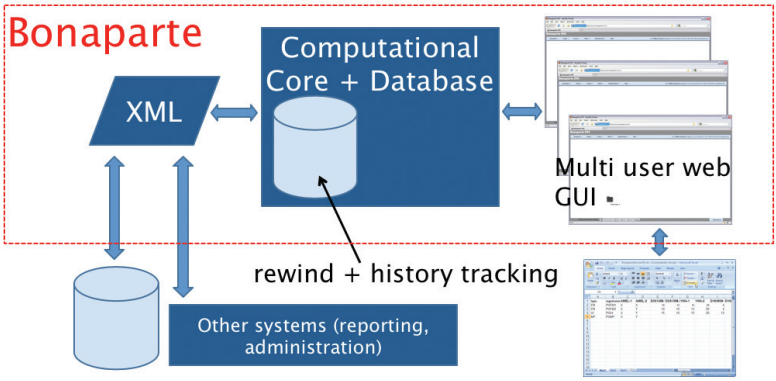
Client-server architecture

Bonaparte is built as a client-server system. This means that the computational core (the part of Bonaparte that actually performs computations) and the Bonaparte database run on a dedicated server. Clients communicate with this server over a network. Since all computations are performed on the server, you don't need powerful expensive client hardware. Bonaparte's architecture allows organizations to easily scale up computational power by connecting multiple servers using a load balancer.

Additional Bonaparte features

- Custom population statistics and mutation models
- Computes arbitrary large pedigrees using STR, mtDNA and Y-STR
- Computes direct matches using STR, mtDNA and/or Y-STR
- Incorporates population statistics for founders without profile
- Computes likelihood ratios for statistical comparison (STR only,mtDNA and Y-STR computations return the number of mismatches)
- Computes number of mistatches in pedigrees in detail
- Allows mutation models to be used
- Allows wildcard values ('F') to denote dropout alleles
- Minimal count method for allele frequencies
- Automated (scheduled) matching procedures using predefined settings
- Matches against elimination profiles to find contaminated samples
- Manual matching procedures using custom settings



Collaboration with the Netherlands Forensic Institute

The development of Bonaparte was done in collaboration with the Netherlands Forensic Institute (NFI). As end-users, they provided valuable information on the definition of the system requirements. During development, they provided feedback on the practical use from an end-user point of view, and at delivery they validated the system, including numerical verifications using independent computations.

[K. Slooten, Validation of DNA-based identification software by computation of pedigree likelihood ratios, Forensic Science International: Genetics, 2010 http://dx.doi.org/10.1016/j.fsigen.2010.06.005]

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Bonaparte DVI Demonstration

A free demonstration version of the Bonaparte system is running on one of our servers. All you have to do is register at http://www.bonaparte-dvi.com and use the credentials we provide you to log on. Some working examples and data to import can be found on the examples page on the website.

www.bonaparte-dvi.com

SNN/Smart Research
PO Box 9101
Internal Code 126
6500 HB Nijmegen
The Netherlands

www.smart-research.nl
Tel. +31(0) 24 3617497
Fax +31(0) 24 3541435